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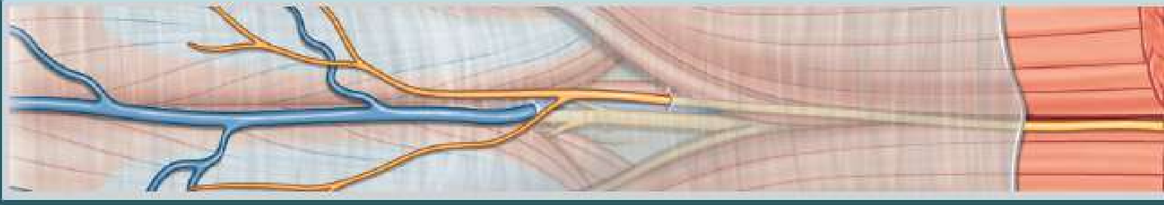
Marios Loukas
R. Shane Tubbs
Brion Benninger

GRAY'S
CLINICAL PHOTOGRAPHIC DISSECTOR OF THE HUMAN BODY



Second Edition

ELSEVIER

GRAY'S CLINICAL PHOTOGRAPHIC DISSECTOR OF THE HUMAN BODY

Second Edition

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I would like to dedicate this book to my brilliant and wonderful wife, Joanna, who has been the bright star of my life. Her continuous support, dedication, love, and affection give me the energy and courage to fulfill all of our dreams.

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BB

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Plates 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.2, 7.1, 7.2, 8.1 to 8.3, 9.1, 9.2, 10.1 to 10.3, 11.1, 12.2 to 12.4, 13.2, 13.3, 14.1, 14.2, 15.1, 15.2, 16.1 to 16.3, 17.1, 17.2, 18.2 to 18.5, 19.1, 19.2, 20.1, 20.2, 21.1, 21.2, 22.1, 22.2, 23.1, 23.2, 24.1, 24.2, 25.1, 26.2, 27.1 to 27.3, 28.1, 28.2, 29.1 to 29.4

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Plates 5.1, 6.1 to 6.4, 12.1, 13.1, 18.1, 22.3, 23.3, 24.3, 24.4, 26.1

Preface

Dissection of the human body, even in the twenty-first century, continues to be the best way of learning the intricacies of the human body. The tactility involved with dissection and the variations in structures between specimens allows the student to gain a much deeper appreciation of human morphology. However, as the time allotted for anatomical education continues to be whittled down in most curricula, courses must continually evolve. Therefore, courses that continue to dissect the human cadaver must utilize all available time wisely. Traditionally, in most anatomy courses that use cadavers, students begin their dissections with the aid of a dissector and follow step-by-step instructions of how to dissect the human body. Such guides, in general, are written much like cookbooks and usually do not provide students with a pictorial step-by-step guide of what to expect during their exploration of the human body. When figures are used by such resources, they are almost always schematic drawings that often look nothing like the actual anatomical structures that are seen by the students. It is this deficit in the extant literature that compelled us to compile dissection photographs with accompanying text to better assist the student of anatomy. It is our hope that being able to see what students are expected to find during their dissection, from superficial to deep, will allow them to be more efficient not only in their learning experience but also with their time.

Marios Loukas
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†Deceased.

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CHAPTER 1 DISSECTION LABORATORY MATERIALS, TOOLS, AND TECHNIQUES

Using appropriate dissection laboratory materials and tools is essential in making the dissection of a cadaver as rewarding as possible. Many experienced dissectors have their favorite tools. Obtaining the following materials and dissection tools allows dissectors to care for their cadaver donor while acquiring experience and knowledge of a successful dissection. Although not comprehensive, this list provides appropriate tools to dissect a cadaver donor in the anatomy teaching laboratory.

MATERIALS

Cadaver Materials

- Blocks
  Plastic or wooden blocks of different shapes and sizes (6–18 inches) can be used to position the cadaver (Fig. 1.1).
- Stands
  Removable stands that either bridge or attach to dissection tables are useful for holding dissection guides, texts, and atlases for dissection.
- Plastic sheets
  Plastic sheets can be used to cover the cadaver, which usually comes with a shroud and a cotton sheet. This helps maintain moisture within the cadaver, to prevent drying, and to allow dissection of appropriately hydrated tissues.
- Cotton sheets
  Surgical green or blue sheets covering a plastic sheet help preserve the cadaver and create a professional working environment.
- Spray bottle with wetting solution
  An individual plastic spray bottle (1 quart) at each cadaver station allows dissectors to maintain good-quality tissue (see Fig. 1.1). An alternative is a 2- to 3-gallon pressure spray unit shared among the dissection laboratory stations.
- Holding container
  The plastic 5- to 10-gallon container with a spigot stores cadaver hydration solution.
- Cadaver hydrating solution
  Several types of mixtures are available to hydrate and maintain cadaver tissue. The authors use a solution with 3000 mL of propylene glycol, 500 mL of ethyl alcohol, and 300 mL of fabric softener, in a 10-gallon holding unit, with the remainder filled with water.
- Cadaver bag
  The bag helps to maintain hydration of the cadaver (Fig. 1.2).

Dissector Materials

- Scrubs
  Comfortable clothing also can be worn with scrubs or under a lab coat.
- Disposable shoe covers
  Shoe covers protect shoes worn in the laboratory during dissection and can be disposed of on exiting the lab, ensuring cleanliness inside and outside the laboratory (Fig. 1.3). Closed-toed shoes should be worn in the dissecting laboratory.
- Goggles
  Protective safety goggles or glasses should be worn at all times during dissection (see Fig. 1.3).
- Face shields
  Shields can be worn when using bone saws or when excessive fluids are present (see Fig. 1.3).
- Gloves
  Gloves vary in the type of synthetic material used; powdered gloves and powder-free gloves are available. (Fig. 1.4). Offer both types to protect dissectors with

mebooksfree

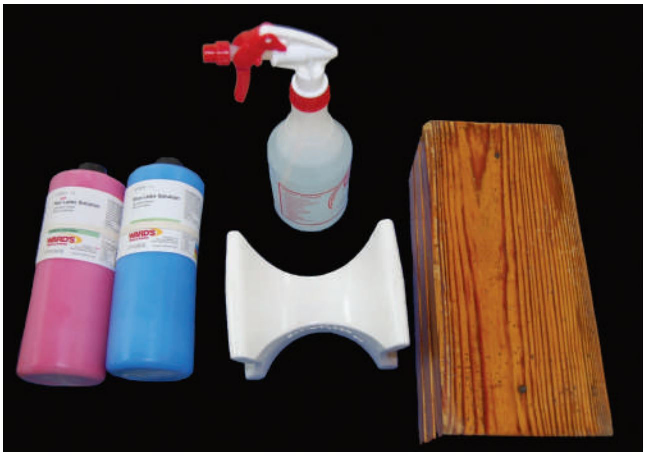

Fig. 1.1 Red and blue latex wrap (to keep cadaver moist); spray bottle; plastic and wooden blocks.

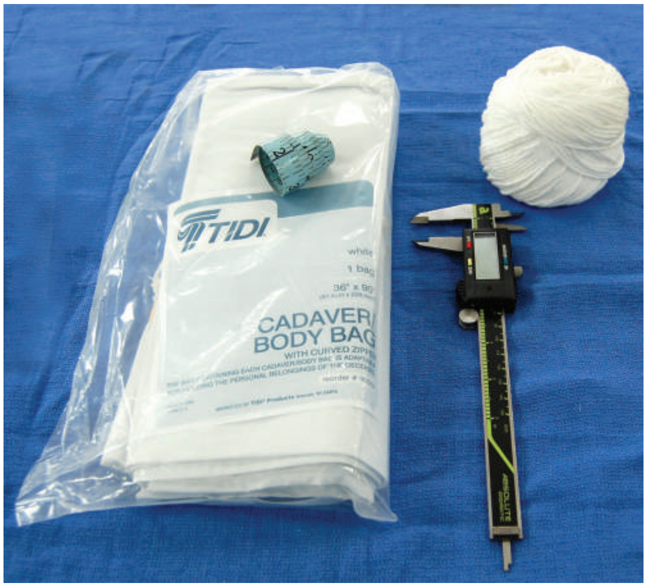

Fig. 1.2 Cadaver bag and cloth measuring tape; ball of string; digital calipers.

different skin sensitivities. *Double gloving* helps to prevent contact with cadaver embalming fluids, which may irritate sensitive skin.

- First-aid kit

  In a dissection laboratory, nicks and pricks are inevitable, so an up-to-date first-aid kit is essential. It should contain adhesive strips (e.g., Band-Aids), cleansing solutions (e.g., hydrogen peroxide), gauze rolls/pads, and eyewash solution. The phone number of the lab director and/or physician should be posted on a wall inside the lab so that users can contact them to answer any emergency issues that may arise if students are allowed to dissect during nonformal hours.

Dissection Tools

- Cloth/measuring tape

  A cloth or paper measuring tape can be invaluable when measuring distances from landmarks of surface anatomy (see Fig. 1.2).

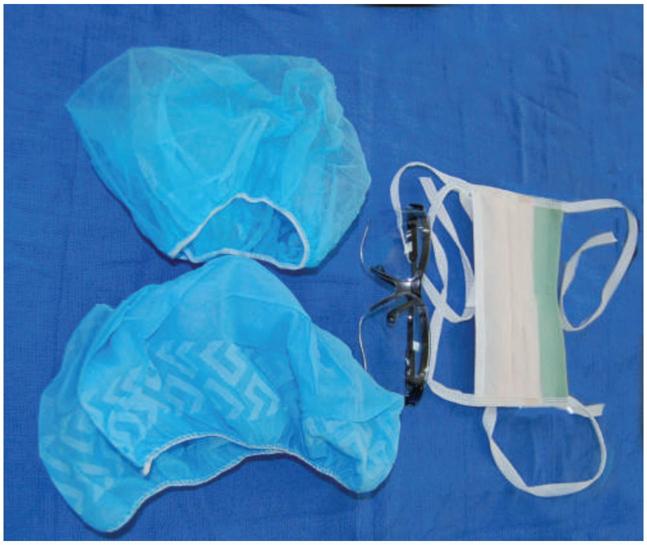

Fig. 1.3 Disposable hair and shoe covers; mask with eye shield; goggles.

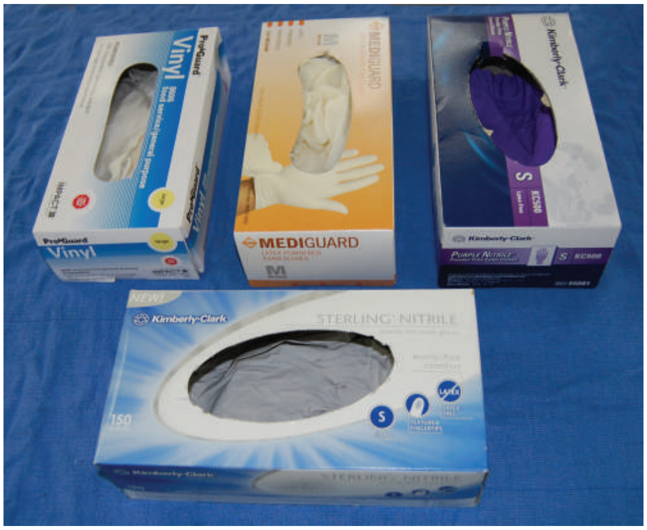

Fig. 1.4 Laboratory gloves differentiated by powder and powder free, latex and latex free.

- Skin marker

  Marking pens can be helpful tools for tracing out the incision before dissection. Markers can also be used to highlight surface anatomy (Fig. 1.5).

- Disposable scalpels

  Disposable scalpels have an advantage because the blade is already secured to the handle. Have a disposable sharps bin in the laboratory (see Fig. 1.5).

- Scalpel handles and blades

  Metal scalpel blades are relatively standardized. Many different blade shapes and sizes are available; however, dissectors should experiment to determine which best suits them and the targets to be dissected. The authors prefer larger blades for their students. Scalpels are used primarily to make skin incisions but also can be used to reflect the dermis and areas with dense connective tissue.

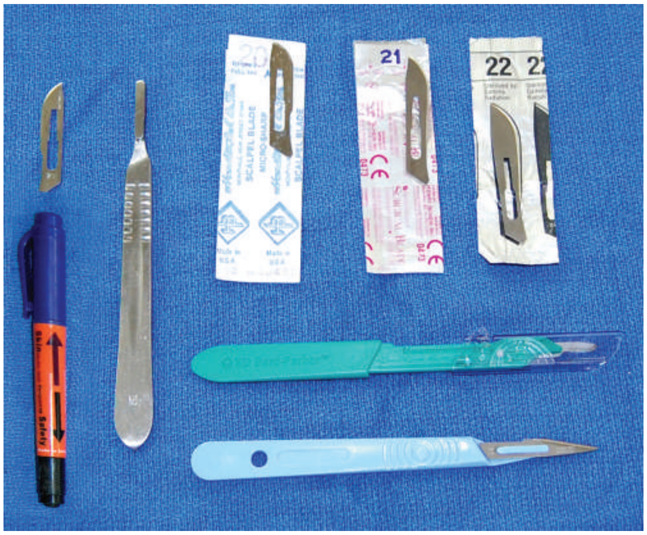

Fig. 1.5 Various scalpel blades and handles (metal and disposable scalpels). An example of a skin marker that can be used for outlining skin incisions is shown.

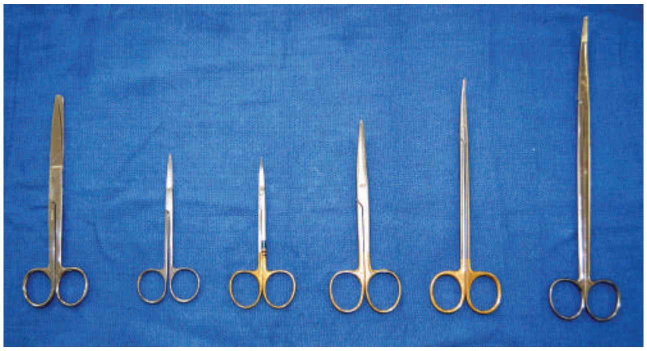

Fig. 1.6 Various scissors differentiated by length and blade type (straight or curved, pointed or blunted): 6-inch Deaver, straight fine scissors, curved fine scissors, 5-inch Mayo, 7-inch Metzenbaum, 9-inch Metzenbaum.

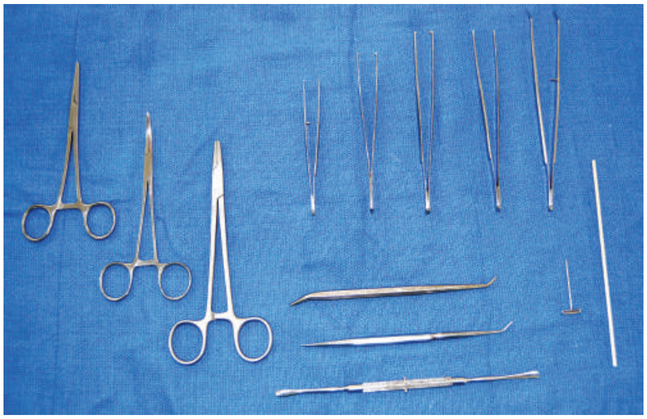

Fig. 1.7 *Left,* Hemostat or artery clamps (straight and curved). *Upper,* Needle holder; various forceps differentiated by length, toothed and nontoothed. *Lower,* Probes and dissectors. *Right,* T-pin and orange stick.

- Sharps bin or container
  For safety compliance, all dissection laboratories should have a sharps bin to dispose of scalpel blades, disposable scalpels, pins, and needles.
- Scissors
  Both 5-inch and 7-inch straight and curved scissors may be used. It is important that the scissors used for each dissection are appropriate in size (Fig. 1.6). Generally, head and neck dissection can be conducted with 5-inch scissors. The remainder of the body can be dissected with 7-inch scissors. The classic scissor dissection technique is a *reverse dissection.* Straight and curved scissors tend to be user specific.
- Hemostat clamps
  Corrugated and smooth, 5-inch and 7-inch hemostat clamps are available (Fig. 1.7). The corrugated type can be used to clamp onto the edge of skin incisions to aid in flap removal. Smooth clamps can be used to hold onto delicate structures during dissection. Hemostat clamps can be used when retracting tissue over relatively long dissection periods.
- Needle holders
  The needle holder allows the user to secure and remove scalpel blades (see Fig. 1.7).
- Forceps
  Toothed and nontoothed forceps are either 5 inches or greater than 5 inches long. Toothed forceps enable the dissector to grip tissue without it sliding out of the hands. Nontoothed forceps allow the dissector to control delicate tissues during meticulous dissection without damaging the tissue (see Fig. 1.7).
- Spatula probe/pointer
  Instruments that have a probe or tip on one end and spatula on the other can be used to highlight dissected structures. The spatula can aid blunt dissection (see Fig. 1.7).
- T-pins
  T-pins (1½–2 inches) are useful in securing structures away from the desired dissection region. T-pins also can be used when setting up laboratory examinations (see Fig. 1.7).
- Chisel (osteotome)
  Narrow-blade and broad-blade chisels are important for performing osteotomies and can help dissect, for example, between the occipital condyles and various vertebrae (Fig. 1.8). Chisels can be used to break up a bone surface to view the soft tissue deep to it (e.g., anterior cranial fossa).
- Rubber mallet
  A mallet is used when striking the chisel to crack surface areas, such as when performing osteotomies (see Fig. 1.8).
- Electric Stryker saw
  Used when cutting bone, the Stryker saw has a safety mechanism that prevents the blade from cutting the user's skin and soft tissue.

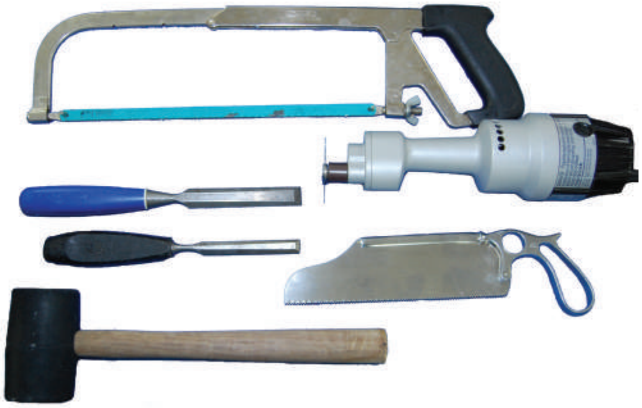

Fig. 1.8 Handsaws (long and short) for bone; electric Stryker bone saw; chisel (broad and narrow blades); rubber mallet.

- Handsaw
  A simple bone saw can be used to customize various dissections and amputations for plastination (see Fig. 1.8). A handsaw is important for hemipelvectomy dissections.

DISSECTION TECHNIQUES

Using the proper technique during dissection is important when developing good dissection skills. Initially, holding the instruments correctly and practicing the techniques may not feel natural. The authors believe that cadaver dissection techniques should reflect the techniques used during surgical procedures. Learning to hold forceps and scissors is fundamental during dissection. These techniques also can be used in the operating room and certain office settings during interventional procedures.

- Scalpel
  The technique for placing a blade onto a scalpel handle requires a hemostat to hold the blade and then place it onto the handle while holding the forceps (Figs. 1.9 and 1.10). When cutting with the blade, use the tip and the first centimeter of the blade. Direct the scalpel using smooth, sweeping motions (Fig. 1.11). Avoid "sawing" and "woodpecker" techniques. Dull blades that require "pushing" the scalpel are dangerous; therefore maintain a sharp blade at all times.
- Forceps
  Hold the forceps as you would hold a pencil, with a pincer grip. The classic mistake is holding the forceps in the palm of the hand as if grasping. Hold the forceps vertically and perpendicularly to the target tissue to allow a 360-degree window of use (Fig. 1.12).
- Scissors
  The appropriate technique when dissecting with scissors is called *reverse dissection* (Fig. 1.13). This requires the user to keep the scissor blades closed when entering into the tissue to be dissected, then opening the blades to create a splaying of the tissue. This results in natural separation of tissue structures and planes. Cut only tissue that is fully exposed so that the desired tissue can be preserved.
- Buttonhole maneuver
  A buttonhole maneuver is helpful when dissecting a flap of dermis. Create a 2-cm parallel incision along the original skin incision, 2 to 3 cm from the edge.

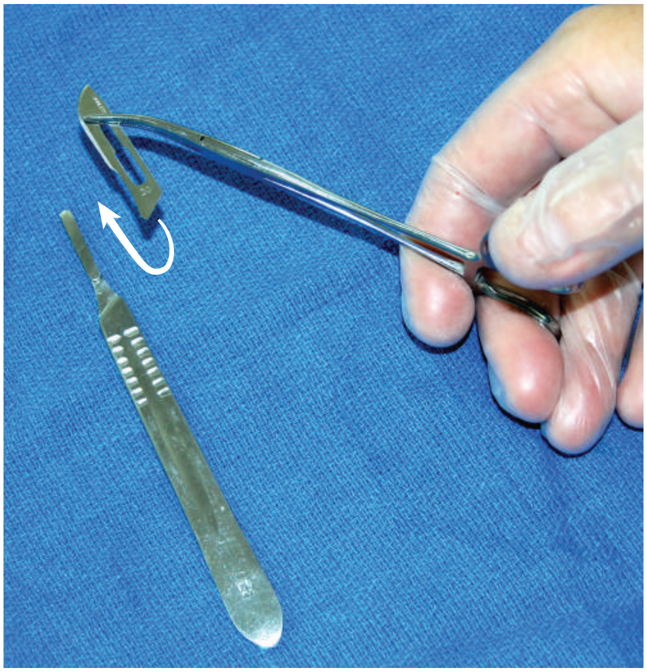

Fig. 1.9 Placing or replacing scalpel blades onto a scalpel handle. Use hemostat or needle holder to grip the scalpel blade. Line up the base angle of the blade with the tip-of-handle angle.

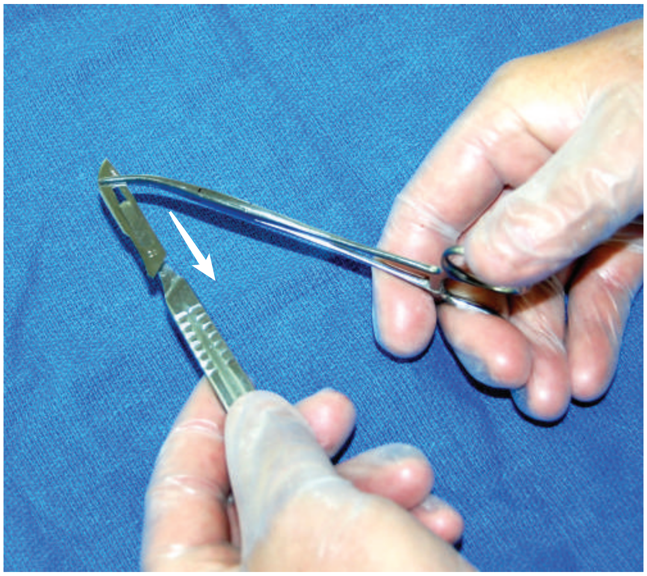

Fig. 1.10 Placing the blade onto the scalpel handle tip. Generally, a clicking sound confirms the blade is secured correctly.

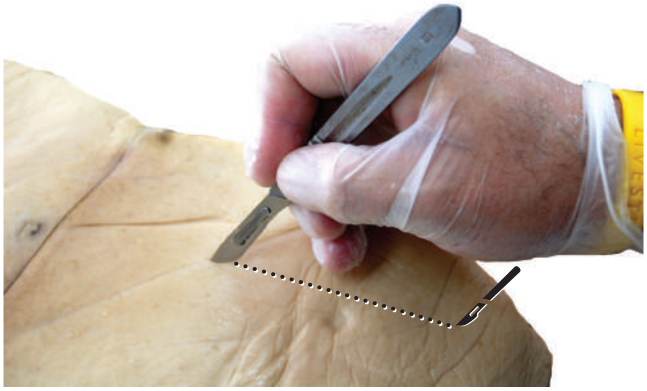

Fig. 1.11 Using the scalpel tip to create skin incisions. Note the grip of the scalpel provides side-to-side and back-to-front blade stability.

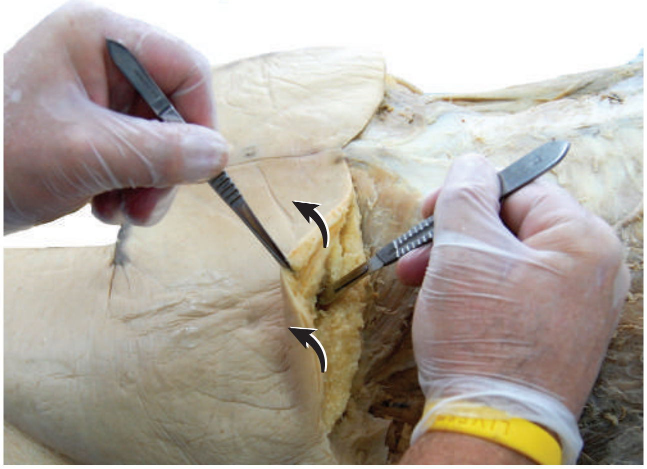

Fig. 1.12 Holding toothed forceps with a 360-degree view and using the scalpel tip between tissue layers while maintaining tension of superficial tissue layer.

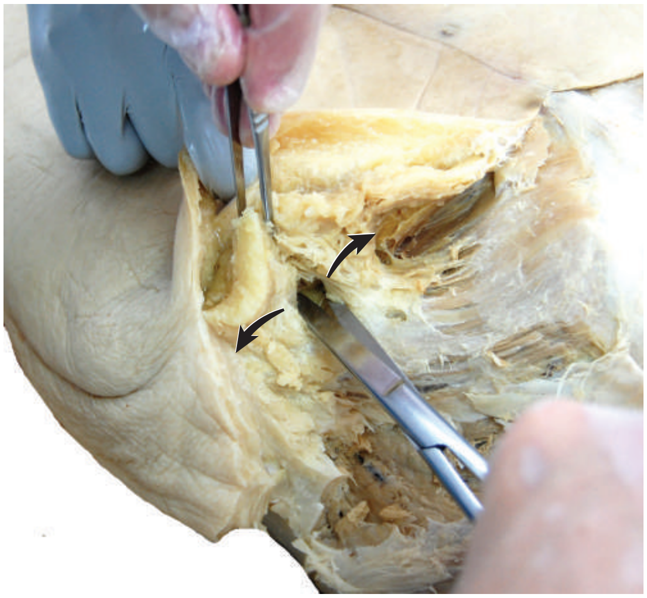

Fig. 1.13 Blunt dissection introduces the scissor tips into the tissue, and then reverse dissection opens the tissue planes.

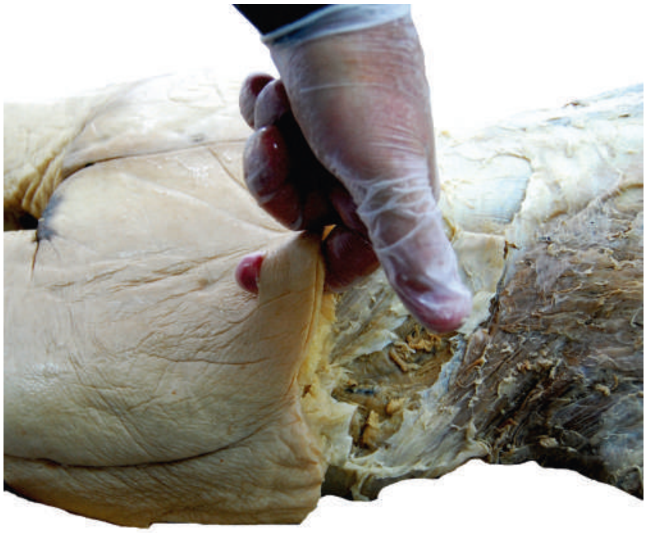

Fig. 1.14 The buttonhole maneuver is helpful when dissecting large skin flaps and provides appropriate tension to expedite dissection. Place your fingertip(s) into the parallel incision and retract with appropriate tension.

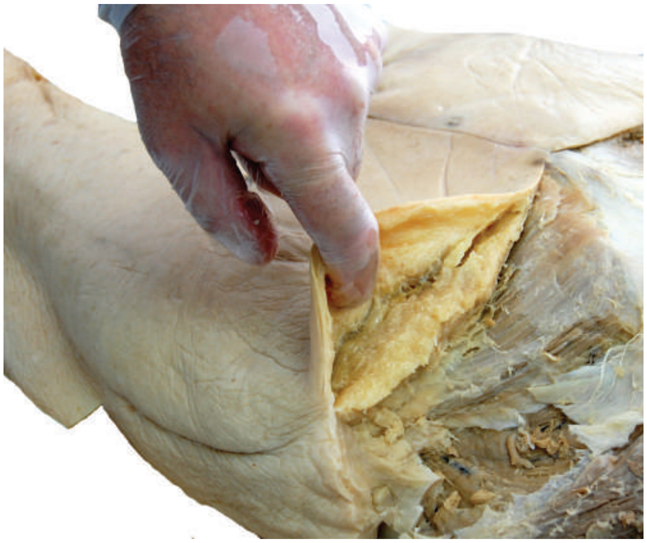

Fig. 1.15 The buttonhole maneuver for retraction of the skin allows adequate visualization of the underlying tissue for further dissection.

Repeat this, generally near the corners of the skin flap. Place your index finger into the parallel incision, and retract the skin flap with appropriate tension that would allow either blunt dissection or a sharp edge to cut the apex of the flap (Figs. 1.14 and 1.15).

- Surface fracturing technique

  The surface fracturing technique requires placing the broad blade of a chisel parallel to the bone and with as much of the blade along the bone. Strike the chisel head with a mallet using a technique that does *not* follow through once the head is struck. The objective is to direct the energy through the blade onto the bony surface, causing multiple fractured segments while protecting the soft tissue beneath the bone (e.g., fracturing anterior cranial fossa plate before superior orbit dissection) (Fig. 1.16).

- Direct fracturing technique

The direct fracturing technique can be performed using a narrow-bladed chisel or by tilting a broad-bladed chisel so that a direct point touches the bone to be fractured. Strike the chisel head with the mallet as if driving a nail. This technique will fracture through a specific part of outer layer of bone (Fig. 1.17).

- Prying technique

The prying technique requires placing the blade of a chisel into the gap created by a handsaw or electric saw. Once in the gap, rotate the chisel blade using a circular motion of the wrist while gripping the chisel to pry the two bony edges apart. Prying is especially useful when performing a craniotomy (see Chapter 23).

- Stryker saw

The technique for using the electric bone saw is performed by placing the blade directly perpendicular to the bone. Place enough pressure onto the bony surface until the blade has gone through the thickness of the bone. Once through the bone, remove the blade, and assess whether the prying technique is required.

- Stryker saw scoring

The scoring technique requires using a Stryker electric saw blade to score the surface of the bone region to be removed. Often an “X” pattern of scoring can weaken the bony cortex. Once the scoring is completed, use the surface fracturing technique. This allows fracture of the cortex and removal of bony fragments without damaging soft tissue beneath the cortex (e.g., removing outer cortex of mandibular ramus; see Chapter 22).

SPECIALIZED MATERIALS TO HIGHLIGHT STRUCTURES

- Latex solutions

Use latex solutions as an injection to highlight vessels, especially small vessels that may not be easily dissectible.

- Needle and syringe

Multiple syringe sizes and needle sizes are used to inject latex or dye into spaces (Fig. 1.18). Injection of the globe (eyeball) with water also may be useful to obtain lifelike qualities.

- Suture material

Multiple sizes of suture material to reattach dissected structures can be useful when demonstrating

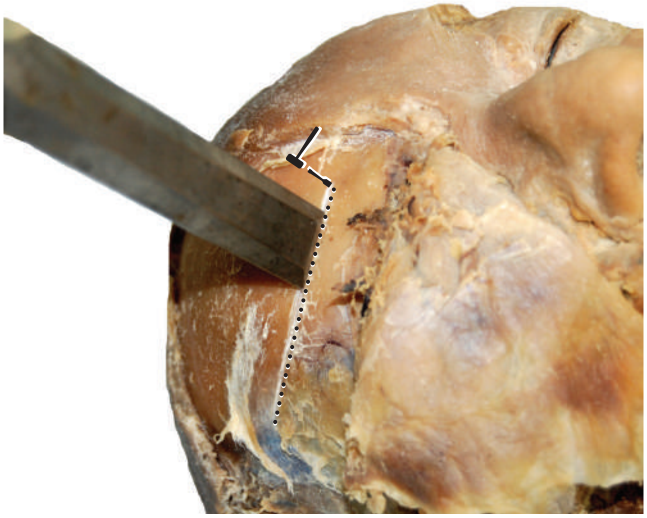

Fig. 1.16 Place chisel blade flat and parallel on the desired bone surface. The surface fracturing technique generally results in multiple fragments protecting the deep tissue.

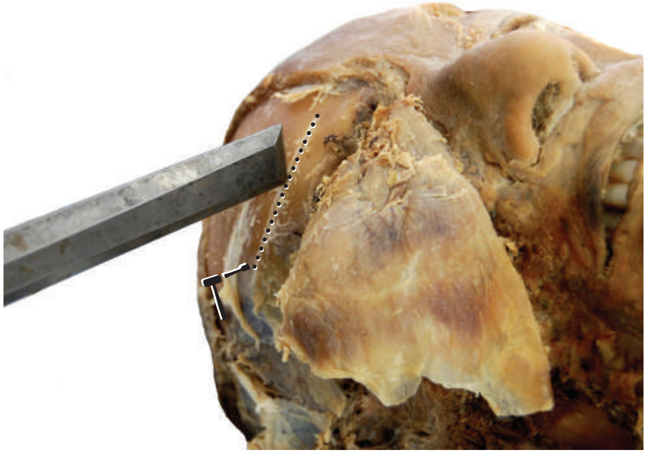

Fig. 1.17 Place chisel blade at an angle on the desired bone surface. The direct fracturing technique creates a specific fracture at the point of the chisel blade.

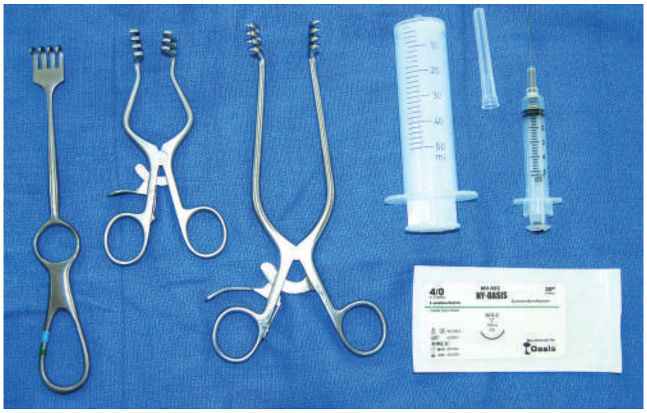

Fig. 1.18 *Left to right,* Handheld retractor (Volkmann); dynamic self-retaining retractors (Weitlaner); syringes (50 mL and 5 mL); suture material.

superficial and deep structures after dissection (see Fig. 1.18).

- Retractors

  Types include (1) single-handled manual retractor for dynamic traction and (2) self-retractor used to retract two sides simultaneously, allowing the dissector to practice surgical procedures without needing others to retract structures manually (see Fig. 1.18).
- Food coloring

  Mix with a solution to inject into the body, to fill up potential spaces and to highlight others.
- Electronic digital calipers

  Use to measure specific length, size, and shape of anatomic structures (see Fig. 1.2).
- Plastination

  The plastination technique preserves dissected regions or structures to be used as *prosected material,* with a life span of 6 months to 20 years, depending on technique, body part, and frequency of use.

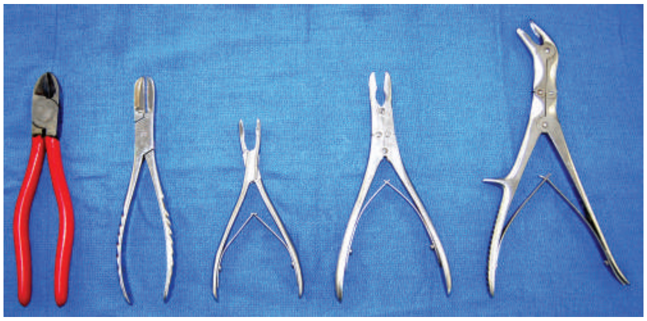

Fig. 1.19 *Left to right,* Metal wire cutters (2), bone cutter (Liston), 5-inch bone-cutter forceps, 7-inch bone-cutter rongeur (Stille).

- Rongeur and rib cutters

  These can be used to cut through small- to medium-sized bones and to customize cut ends of all bone sizes (Fig. 1.19).

CHAPTER 2 MUSCLES OF THE BACK AND SCAPULA

ATLAS REFERENCES*

Netter: 180–183, 257, 413–418
McMinn: 101–103, 131–136, 144
Gray's Atlas: 20–32, 36–42, 399, 400

BEFORE YOU BEGIN

Make sure that you have palpated the following anatomic landmarks on yourself and classmates:

- Superior nuchal line
- External occipital protuberance (inion)
- Mastoid process
- Spinous process of the 7th cervical vertebra (C7, vertebra prominens)
- Spinous process of the thoracic and lumbar vertebrae, the sacrum, and the coccyx
- Medial and lateral parts of the clavicles
- Iliac crests
- Trapezius muscle
- Latissimus dorsi muscle
- Deltoid muscle
- Triceps brachii muscle
- Acromion

SKIN AND SUPERFICIAL FASCIA

○ **Begin by palpating bony landmarks. With a marker, draw the following lines on the skin of the cadaver (Fig. 2.1):**

1. From the external occipital protuberance, down the midline of the back to the sacrum.
2. Laterally, from the external occipital protuberance to the mastoid process on each side of the cadaver.
3. Laterally, from the spinous process of the vertebra prominens to the acromion of each shoulder.
4. Superiorly from the sacrum, curving obliquely over the iliac crests to the midaxillary line on each side of the body; that is, to a point about halfway around the upper edge of each iliac crest.

○ **Incise the skin along the lines just described, beginning at the point where the incisions for the midline and from the shoulders meet (Fig. 2.2).**

○ **Retract the skin carefully (with toothed forceps), leaving the fat (superficial fascia) intact (see Fig. 2.2).**

DISSECTION TIP

Place absorptive cloths at the inferolateral spaces of the iliac crest. Excessive amounts of embalming fluid often accumulate at this location.

DISSECTION TIP

Make necessary "buttonholes" in the skin to facilitate the dissection (Fig. 2.3), as indicated in Chapter 1.

○ **On one side of the body, the dissectors should first reflect only the skin, leaving the superficial fascia (tela subcutanea) in place.**

○ **Start the separation of the superficial fascia from the underlying deep fascia in the midline, by identifying a small part of the trapezius muscle.**

○ **Carefully scrape off the superficial fascia from the surface of the muscle with your scalpel (Fig. 2.4).**

DISSECTION TIP

As the superficial fascia is reflected, watch for the passage of neurovascular bundles from the deep fascia into the deep surface of the superficial fascia. Save short segments of several of these for later demonstration and review.

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*NOTE: This dissection guide is cross-referenced to the following atlases: Netter, *Atlas of Human Anatomy,* ed 7 (Netter); *McMinn's Clinical Atlas of Human Anatomy,* ed 7 (McMinn); and *Gray's Atlas of Anatomy,* ed 2 (Gray's). Page references from each atlas are provided at the beginning of Chapters 2 through 29 to give you the opportunity to study the relevant anatomy in depth to aid in your dissection.

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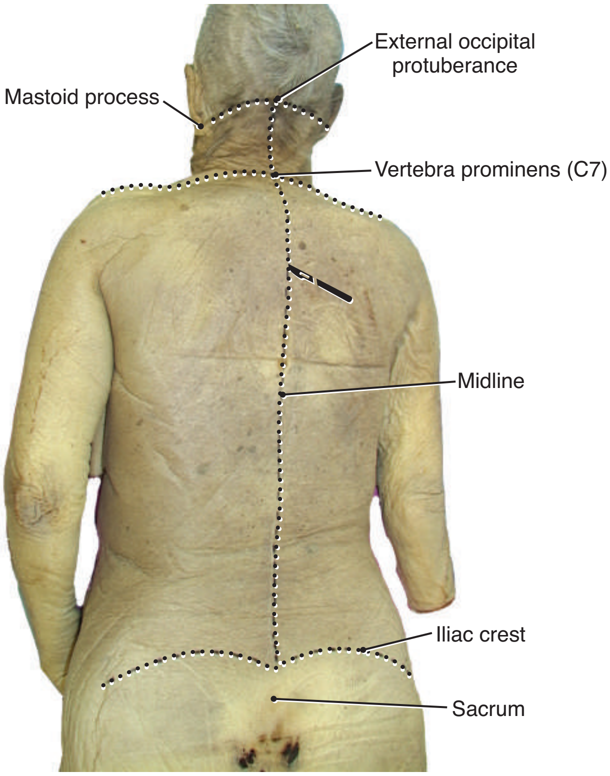

External occipital protuberance
Mastoid process
Vertebra prominens (C7)
Midline
Iliac crest
Sacrum

Fig. 2.1 Skin markings for incision lines: neck and back.

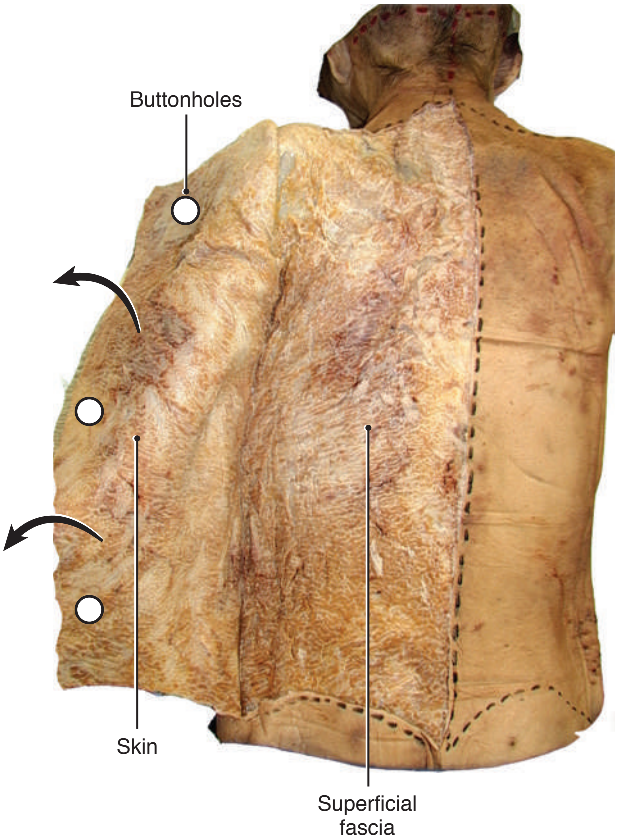

Buttonholes
Skin
Superficial fascia

Fig. 2.3 Make "buttonholes" in the skin to facilitate its reflection from the superficial fascia.

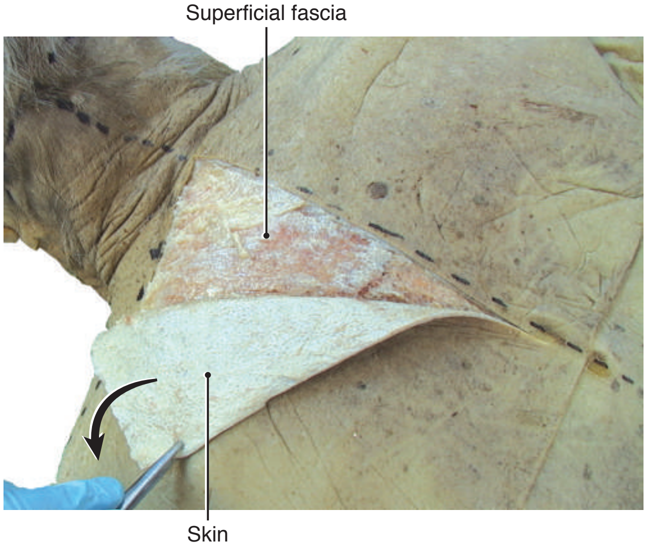
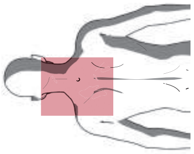

Superficial fascia
Skin

Fig. 2.2 Reflection of skin from superficial fascia.



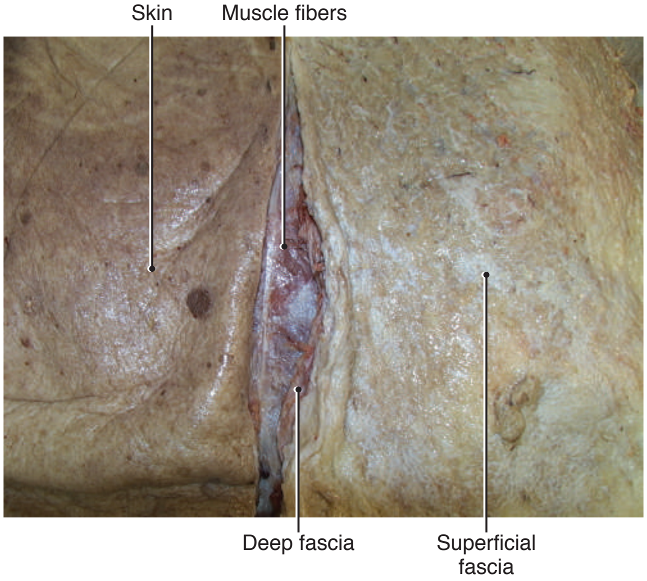

Skin
Muscle fibers
Deep fascia
Superficial fascia

Fig. 2.4 Deep skin incisions showing deep fascia and muscle fibers.

DISSECTION **TIP**

Take precautions to avoid cutting too deeply with the scalpel. In some cadavers, the superficial fascia is very thin, and more deeply situated structures can be cut and destroyed (Figs. 2.5 and 2.6).

- **Completely remove superficial fascia over the latissimus dorsi muscle.**
- **On the other side of the body, the skin and superficial fascia can be reflected together.**

DISSECTION **TIP**

Care must be taken in this latter approach to avoid damage to the underlying muscles, especially the trapezius and latissimus dorsi muscles and their aponeuroses. Identify these before the skin and fascia are reflected more than a few centimeters.

SUPERFICIAL MUSCLES OF THE BACK: PART 1

- **Remove enough deep fascia to clarify the borders of the two most superficial muscles of the back, the trapezius and latissimus dorsi (Fig. 2.7).**

ANATOMY **NOTE**

Note the diamond-shaped aponeurotic area of the trapezius at the upper middle thoracic region (see Fig. 2.7). The skin, superficial fascia, and deep fascia are relatively thin here. This is in contrast to the lateral lumbar region, where the amount of subcutaneous fat is increased (see Fig. 2.6).

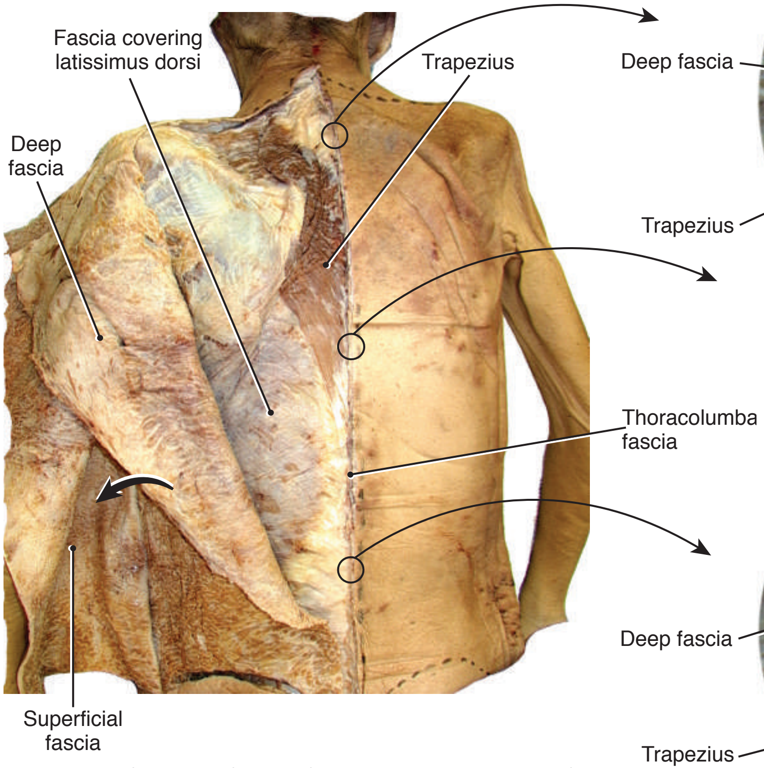

Fascia covering latissimus dorsi
Trapezius
Deep fascia
Thoracolumba fascia
Superficial fascia

Fig. 2.5 Reflection of deep fascia and appearance of trapezius, latissimus dorsi, and thoracolumbar fascia.

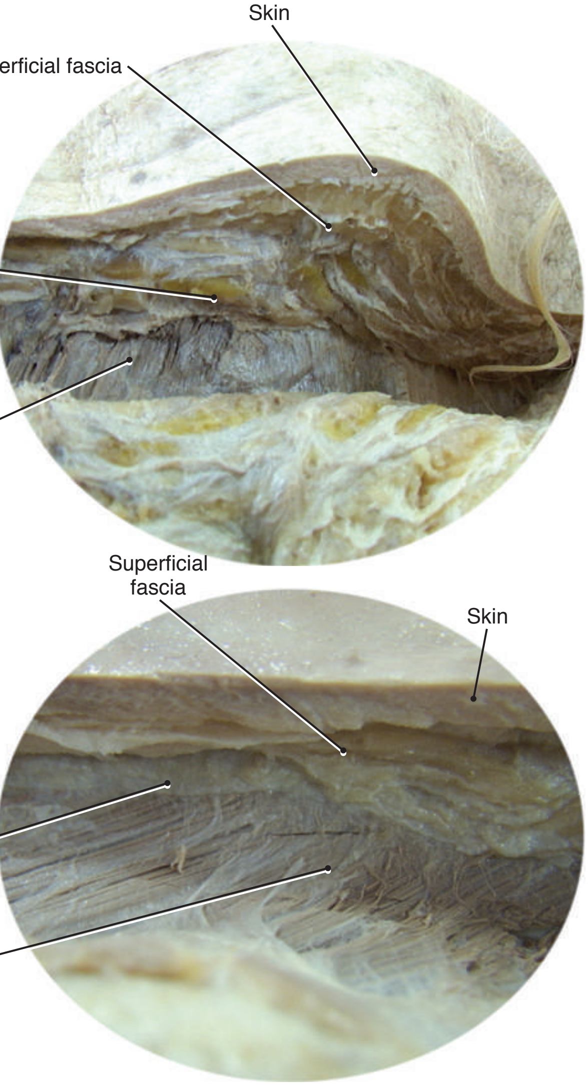

Skin
Superficial fascia
Deep fascia
Trapezius
Superficial fascia
Skin
Deep fascia
Trapezius

Fig. 2.6 Note possible differences in thickness of the skin and fascia. Avoid cutting too deeply with the scalpel to prevent damage to superficial structures when exposing them.

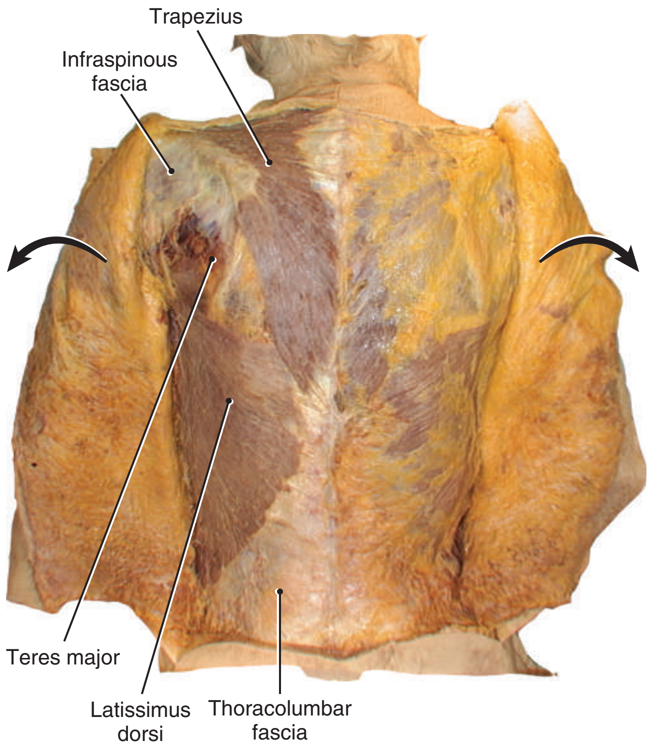

Trapezius
Infraspinous fascia
Teres major
Latissimus dorsi
Thoracolumbar fascia

Fig. 2.7 Complete removal of superficial fascia over trapezius, latissimus dorsi, and posterior layer of thoracolumbar fascia on left side of cadaver. Deep fascia and some adipose tissue have been left intact on right side.

- Identify the teres major muscle and the infraspinous fascia (see Fig. 2.7).

ANATOMY **NOTE**

This fascia covering the infraspinatus muscle is attached to the margins of the infraspinous fossa and is continuous with the deltoid fascia along the posterior border of the muscle.

- Carefully separate the deep fascia covering the trapezius muscle (Fig. 2.8).
- While cleaning away the fascia that overlies the most cranial portion of the trapezius (Figs. 2.9 and 2.10), look for the greater occipital nerve.
- This nerve usually can be found approximately 1 inch (2.5 cm) from the midline and 1 inch inferior to the superior nuchal line, as the nerve pierces the trapezius (Figs. 2.11 and 2.12).
- Also at this location, locate the occipital artery, and preserve it as the trapezius is reflected (see Fig. 2.12).

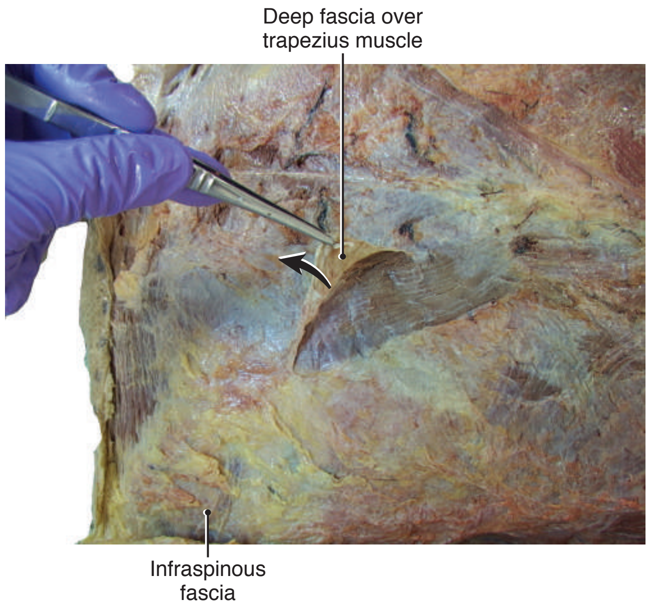
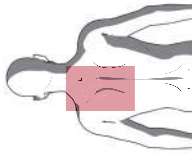

Deep fascia over trapezius muscle
Infraspinous fascia

Fig. 2.8 Careful separation of deep fascia covering trapezius muscle.



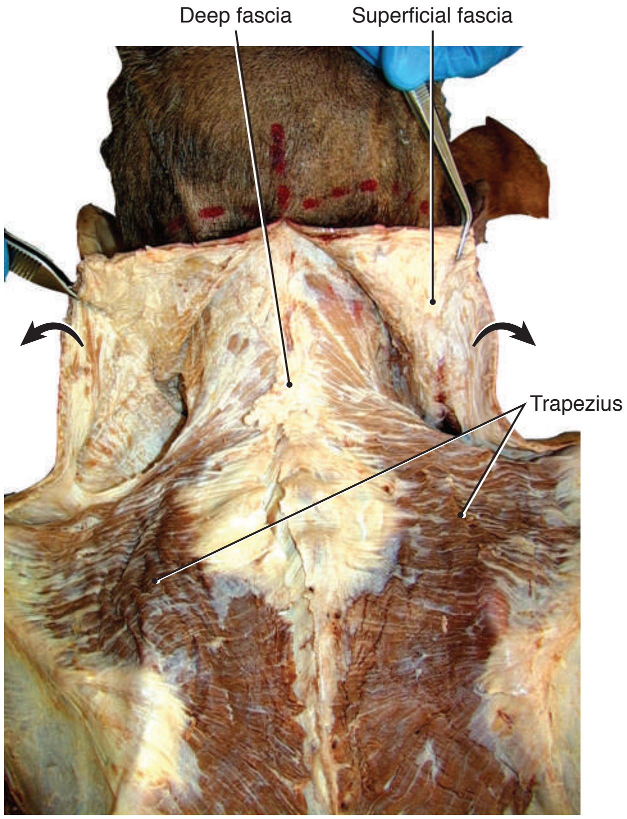
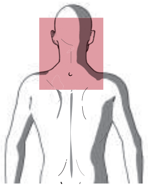

Deep fascia
Superficial fascia
Trapezius

Fig. 2.9 Exposure of superior part of trapezius with portions of deep fascia still covering its uppermost portion.



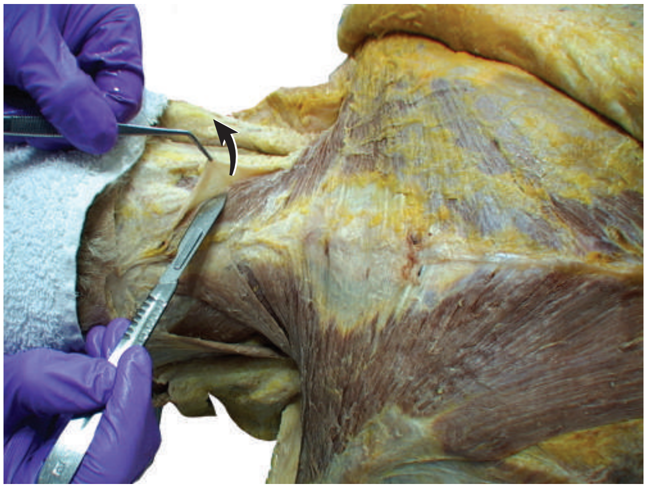
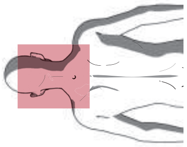


Fig. 2.10 Exposure of deep fascia covering the upper portion of trapezius.



DISSECTION TIP

GREATER OCCIPITAL NERVE

To identify the greater occipital nerve, draw a horizontal imaginary line from the external occipital protuberance to the mastoid process. At 3 cm lateral to the external occipital protuberance on the imaginary line, remove the deep fascia to identify this nerve.

3RD OCCIPITAL NERVE

Usually the deep fascia over the trapezius muscle below the superior nuchal line is very thick and difficult to cut until the 7th cervical vertebra (C7) level. Pay special attention to the dissection process. Intermingled with the deep fascia over this area is the **3rd occipital nerve;** try to expose and save it (Fig. 2.13).

- To detach the trapezius from its origin, first make a small vertical cut through the lower part of the trapezius at the 12th thoracic vertebra (T12) level as it attaches to the midline.
- Continue the incision to the external occipital protuberance. Define and loosen the trapezius with your fingers or with scissors before you proceed further upward along the midline (Fig. 2.14).
- Detach the trapezius from its origin on the superior nuchal line and the external occipital protuberance, and sever the fibers that arise from the spines and associated ligaments of the cervical and thoracic vertebrae. Reflect the trapezius laterally toward its insertion onto the scapula (Fig. 2.15).
- On the deep surface of the trapezius, near the superior angle of the scapula, look for the nerve that supplies the trapezius, the accessory nerve.

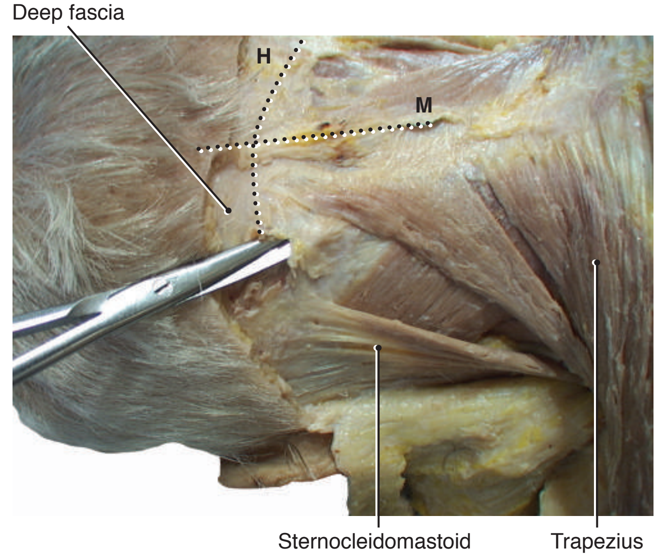


Fig. 2.11 After identifying the greater occipital nerve, separate and remove the deep fascia; *M,* midline; *H,* horizontal line.

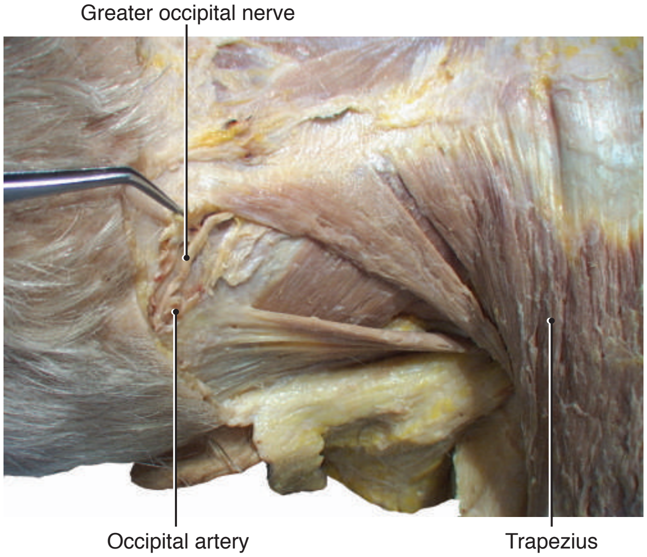


Fig. 2.12 Deep fascia is cut, and the greater occipital nerve and occipital artery are visible.

- Note the artery that supplies the trapezius muscle, the ascending branch of the transverse cervical artery.
- Identify the levator scapulae, rhomboid minor and major muscles, and neurovascular bundle (Fig. 2.16).
- Clean the fascia from these muscles so that their fibers can be seen clearly.

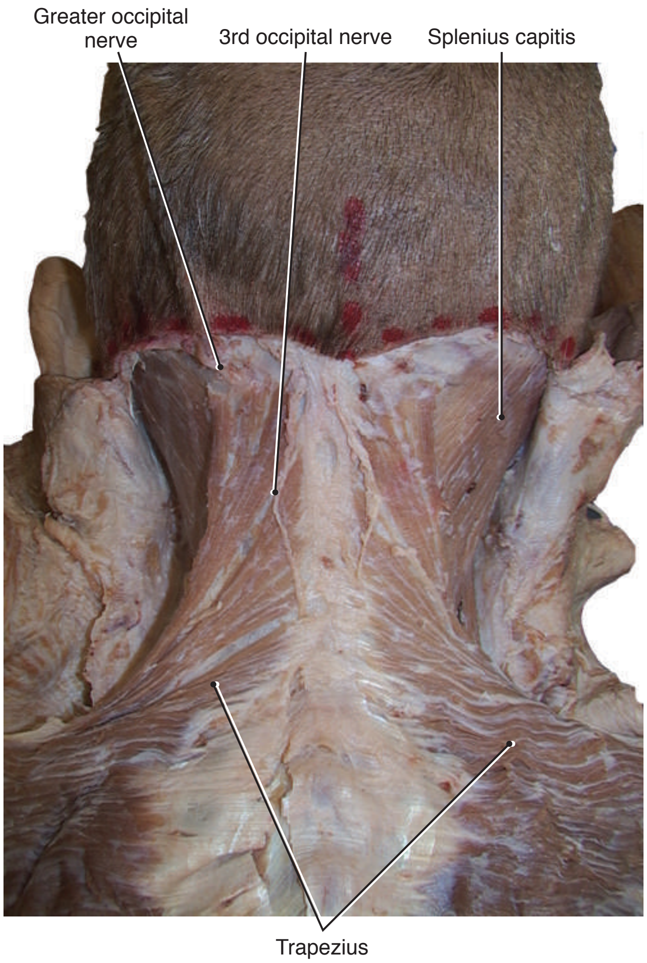
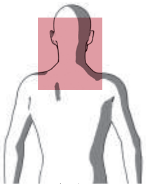

Greater occipital nerve
3rd occipital nerve
Splenius capitis
Trapezius

Fig. 2.13 Complete exposure and detachment of the superior part of the trapezius from the deep fascia. Observe the 3rd occipital nerve.



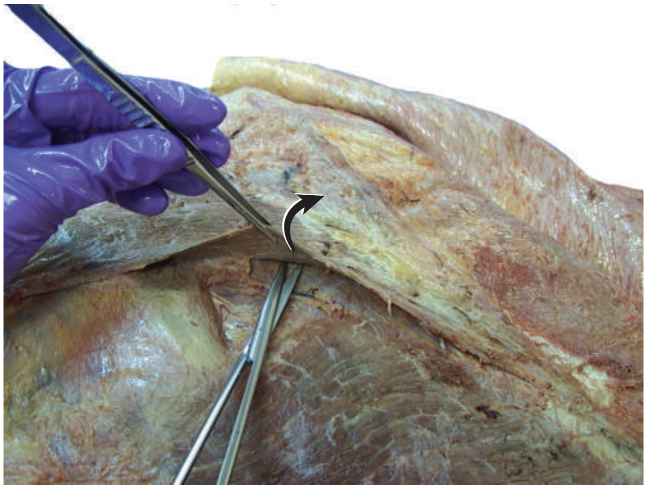
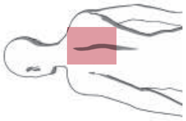


Fig. 2.14 Dissection of lateral trapezius muscle facilitated by a separation technique using dissecting scissors.



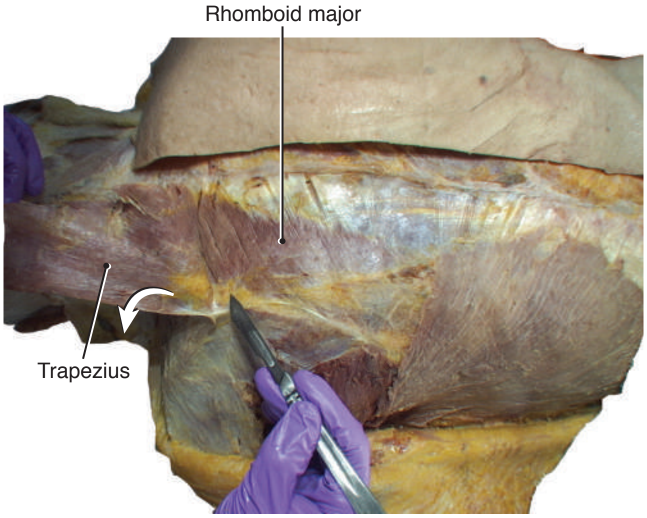
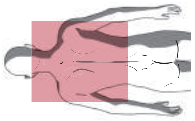

Rhomboid major
Trapezius

Fig. 2.15 Separation of the connective tissue on the deep surface of trapezius.



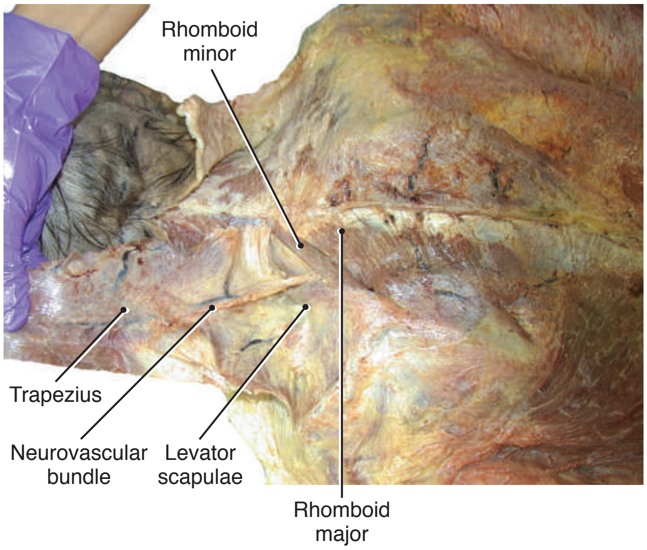
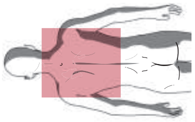

Rhomboid minor
Trapezius
Neurovascular bundle
Levator scapulae
Rhomboid major

Fig. 2.16 Complete reflection of the trapezius and appearance of the underlying levator scapulae and rhomboid muscles, and neuromuscular bundle.



- Gently retract the levator scapulae muscle medially. At the midpoint of the levator, you will see the accessory nerve exit and run on the internal surface of the trapezius muscle (Figs. 2.17 and 2.18).
- Carefully separate the neurovascular bundle to identify the accessory nerve, ascending branch of the transverse cervical artery, and tributaries of transverse cervical vein (Figs. 2.19 and 2.20).
- Carefully expose the deep fascia over the rhomboid major and minor muscles. In some specimens the line

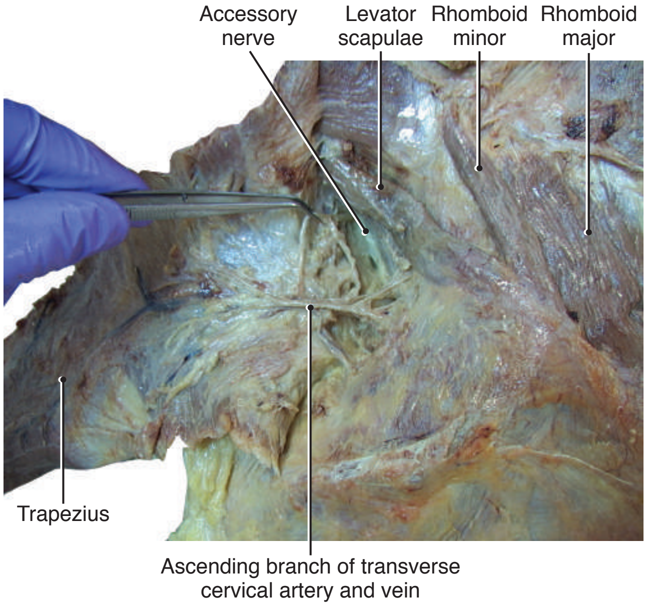
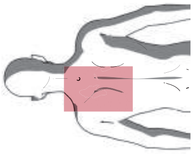

Accessory nerve
Levator scapulae
Rhomboid minor
Rhomboid major
Trapezius
Ascending branch of transverse cervical artery and vein

Fig. 2.17 Identification of accessory nerve, emerging deep from medial side at midpoint of levator scapulae muscle.



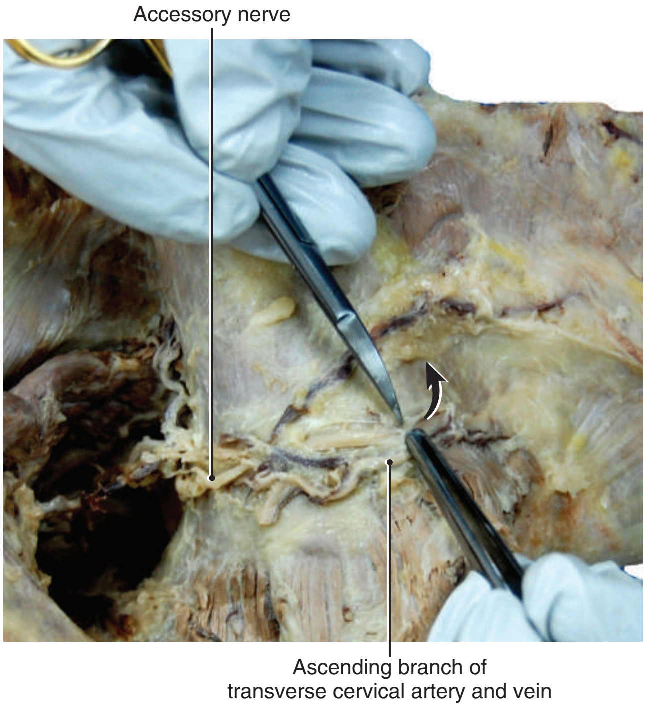
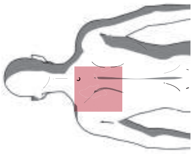

Accessory nerve
Ascending branch of transverse cervical artery and vein

Fig. 2.18 Careful separation of neurovascular bundle to identify accessory nerve, ascending branch of transverse cervical artery, and tributaries of transverse cervical vein.



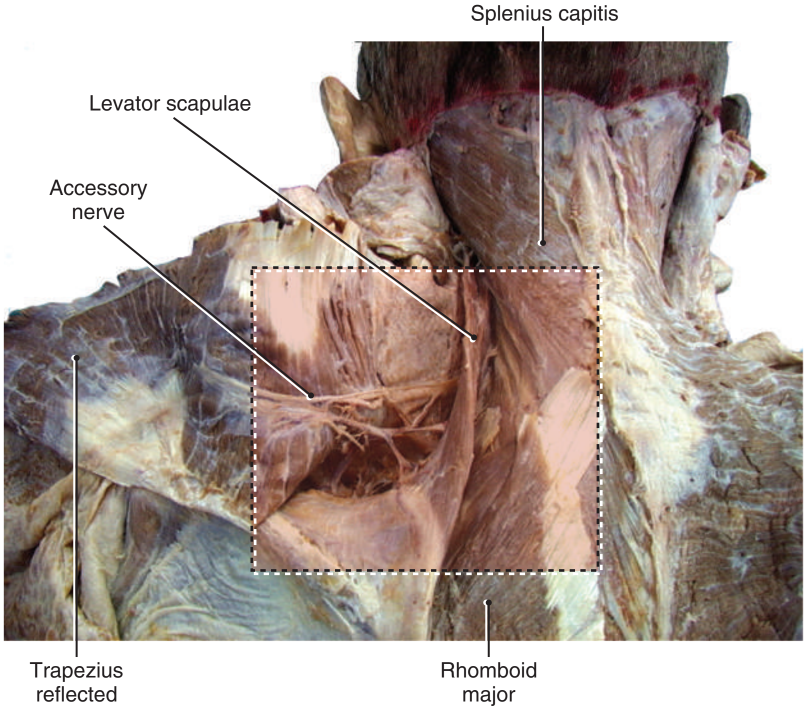
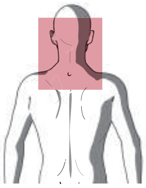

Splenius capitis
Levator scapulae
Accessory nerve
Trapezius reflected
Rhomboid major

Fig. 2.19 After careful dissection of connective tissue, trapezius muscle is reflected and accessory nerve identified.



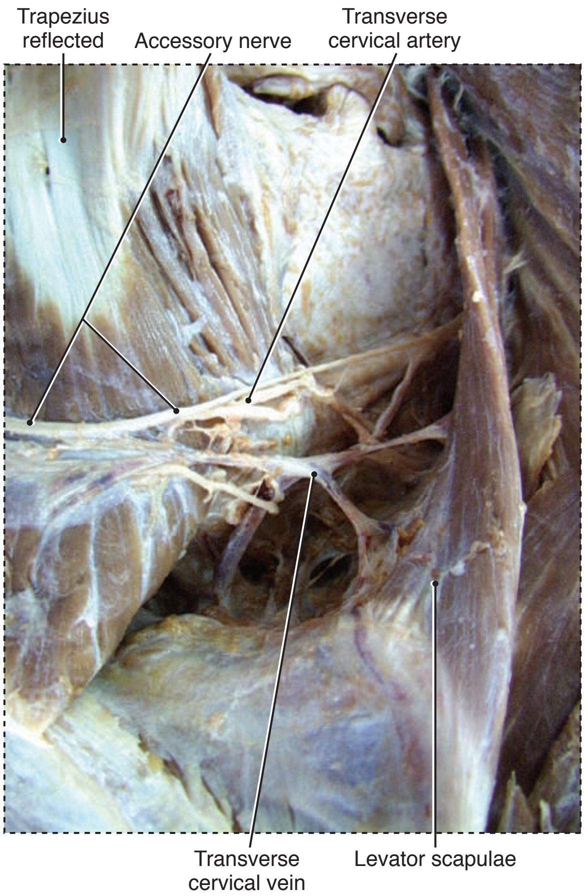
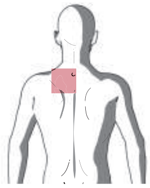


Fig. 2.20 Trapezius muscle is reflected and the accessory nerve identified.



of cleavage between the rhomboid muscles may be unclear (Figs. 2.21 and 2.22).

- Reflect the rhomboid muscles laterally toward their insertion onto the medial border of the scapula (Fig. 2.23) (Plate 2.1).
- Deep to the rhomboids, identify the serratus posterior superior muscle, which inserts onto the ribs rather than onto the scapula. (This fact will assist you in its identification.)
- On the deep surface of the rhomboids, try to identify the dorsal scapular nerve and dorsal scapular artery (Fig. 2.24).

ANATOMY **NOTE**

The dorsal scapular nerve innervates the rhomboid and levator scapulae muscles (in addition to branches from C3 and C4). The dorsal scapular nerve arises from C5, one of the two nerves that arise directly from the ventral rami of the brachial plexus.

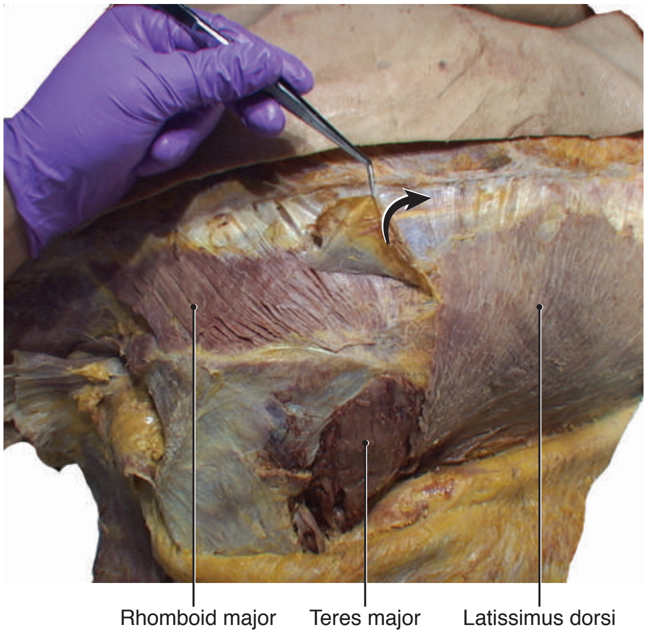
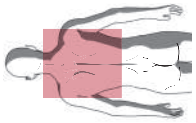


Fig. 2.21 Carefully expose deep fascia over the rhomboid major and minor muscles.



ANATOMY **NOTE**

In about 50% of the specimens, the dorsal scapular artery is absent, and the deep branch of the transverse cervical artery replaces it. The dorsal scapular artery typically arises from the 3rd part of the subclavian artery and runs posteriorly through the brachial plexus.

MUSCLES OF THE SCAPULA

ANATOMY **NOTE**

The infraspinous fascia is attached to the scapula around the boundaries of the attachments of the infraspinatus, teres minor and major, long head of triceps brachii, and deltoid muscles.

- Clean the teres major muscle (Fig. 2.25).
- Identify the teres minor and deltoid muscles and the long head of triceps brachii (Fig. 2.26).

ANATOMY **NOTE**

The fibers of the teres minor muscle run more or less parallel to the fibers of the teres major and are medial to the long head of the triceps brachii and deltoid muscles (see Fig. 2.25).

- Beginning superiorly, reflect the infraspinous fascia to expose the long head of triceps and deltoid muscles (Figs. 2.27 and 2.28).

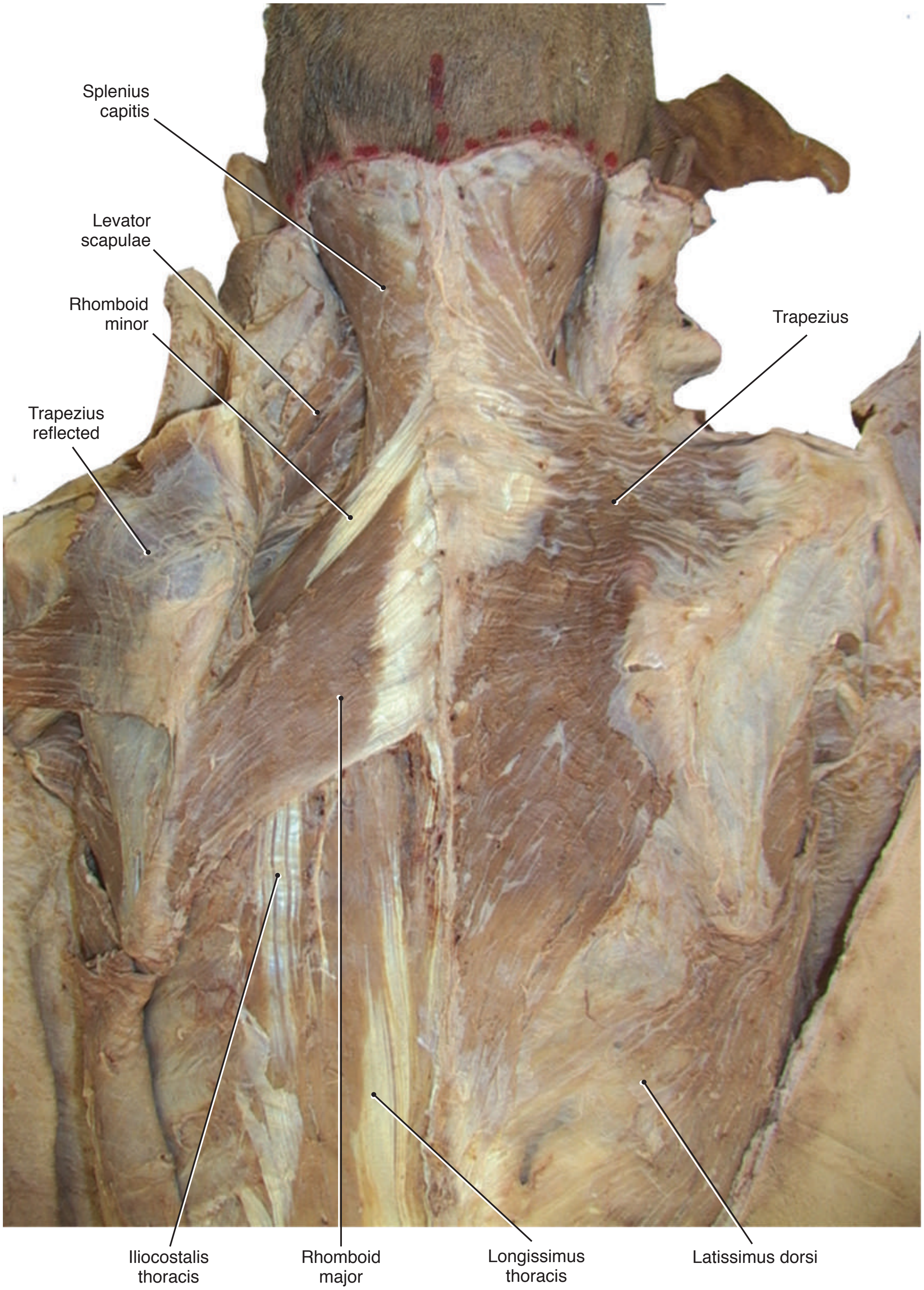
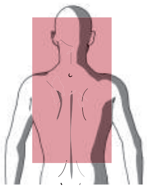

Splenius capitis
Levator scapulae
Rhomboid minor
Trapezius reflected
Trapezius
Iliocostalis thoracis
Rhomboid major
Longissimus thoracis
Latissimus dorsi

Fig. 2.22 Trapezius and latissimus dorsi muscles are reflected. Underlying intermediate extrinsic muscles of the back are exposed.



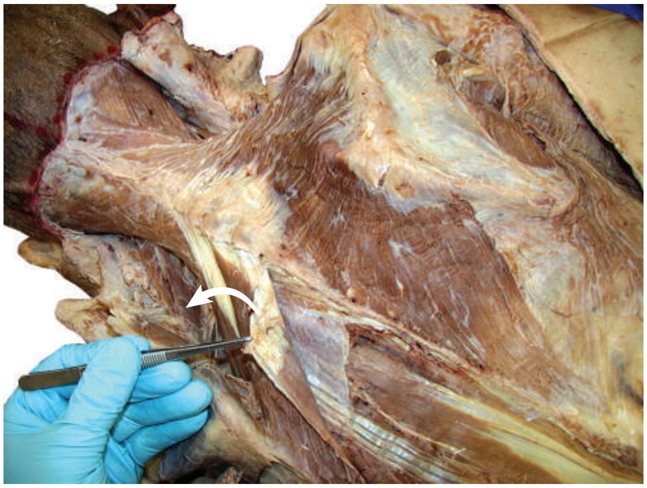
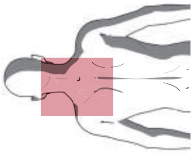


Fig. 2.23 After the trapezius is exposed, reflect the rhomboid major and minor muscles carefully to expose the serratus posterior superior.



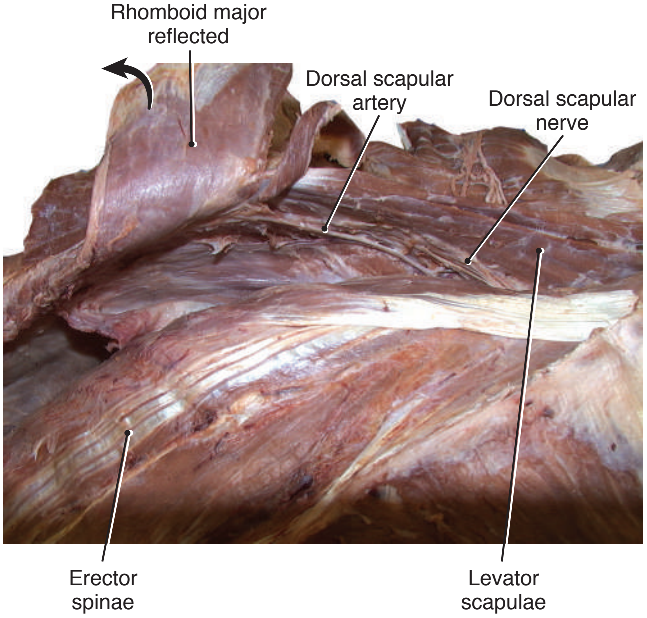
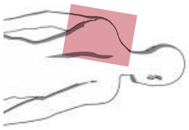
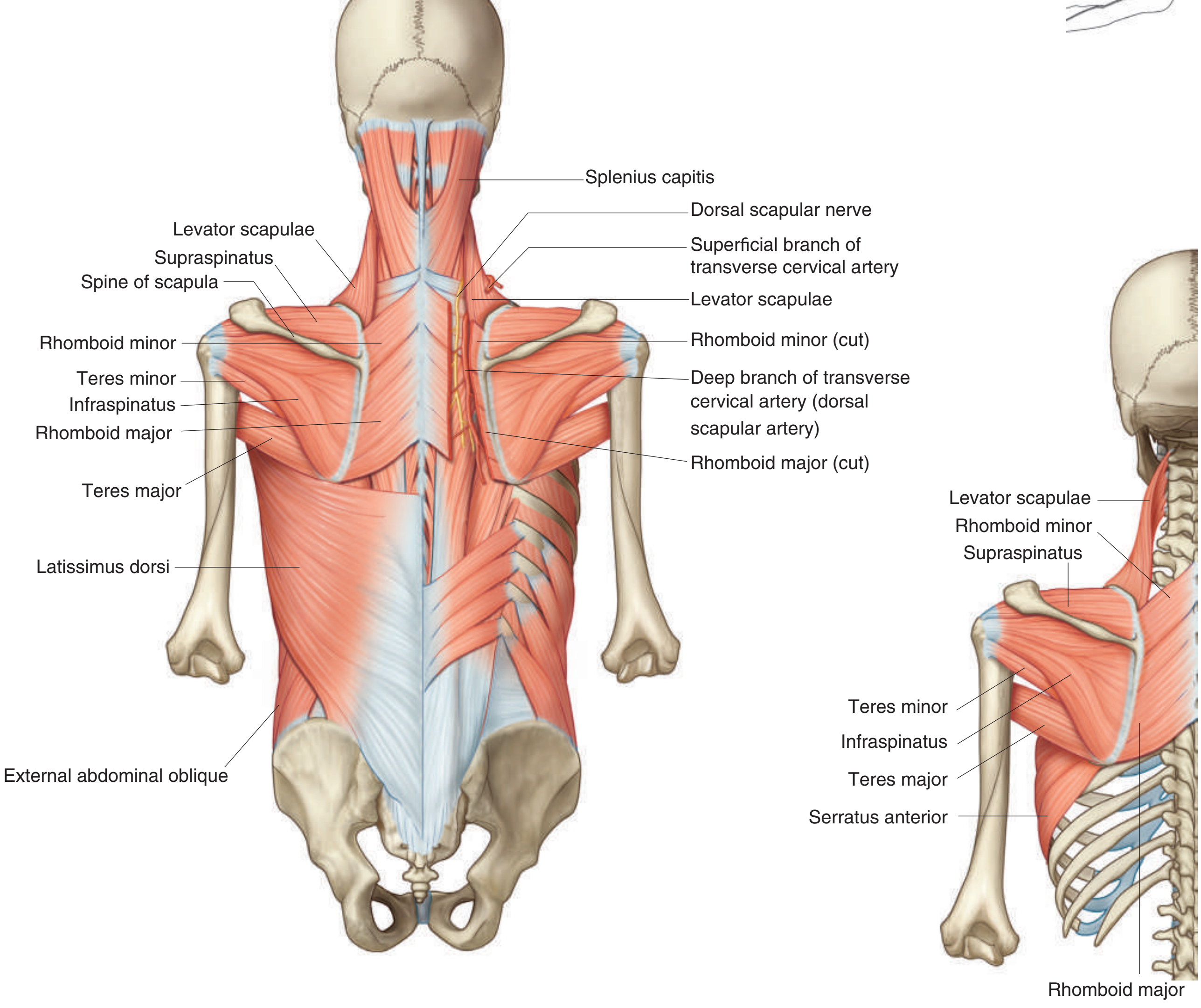

Rhomboid major reflected
Dorsal scapular artery
Dorsal scapular nerve
Erector spinae
Levator scapulae

Fig. 2.24 View of deep surface of scapula illustrating dorsal scapular artery and nerve running at the medial border of scapula.




Splenius capitis
Dorsal scapular nerve
Levator scapulae
Supraspinatus
Spine of scapula
Superficial branch of transverse cervical artery
Levator scapulae
Rhomboid minor
Rhomboid minor (cut)
Teres minor
Infraspinatus
Rhomboid major
Deep branch of transverse cervical artery (dorsal scapular artery)
Rhomboid major (cut)
Teres major
Latissimus dorsi
External abdominal oblique
Levator scapulae
Rhomboid minor
Supraspinatus
Teres minor
Infraspinatus
Teres major
Serratus anterior
Rhomboid major

Levator scapulae and rhomboid major and minor

Plate 2.1 Superficial musculature of the back.

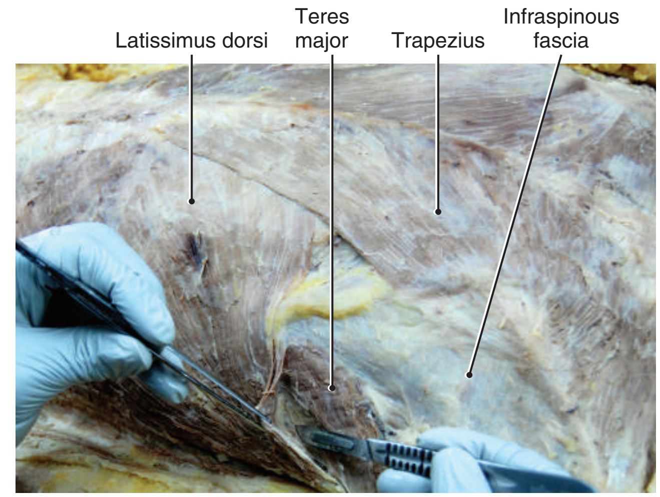
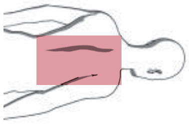

Latissimus dorsi
Teres major
Trapezius
Infraspinous fascia

Fig. 2.25 Careful separation of teres major from upper border of latissimus dorsi muscle.



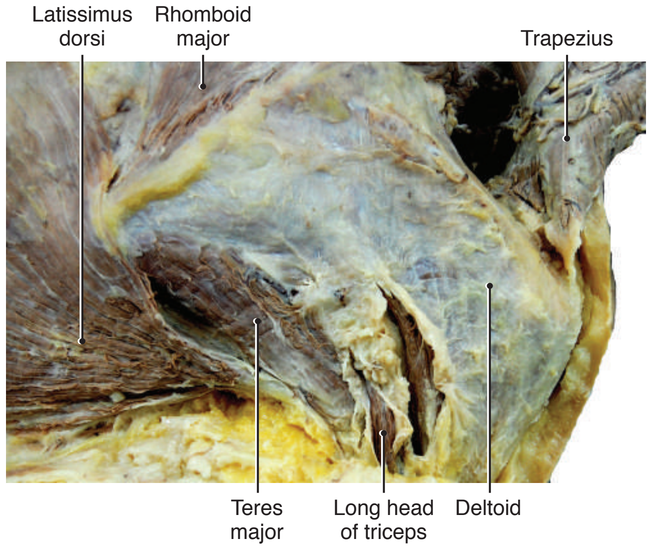
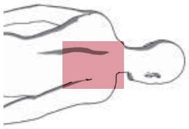

Latissimus dorsi
Rhomboid major
Trapezius
Teres major
Long head of triceps
Deltoid

Fig. 2.26 View of deltoscapular region. Long head of triceps brachii and deltoid muscles are exposed after careful separation from infraspinous fascia.



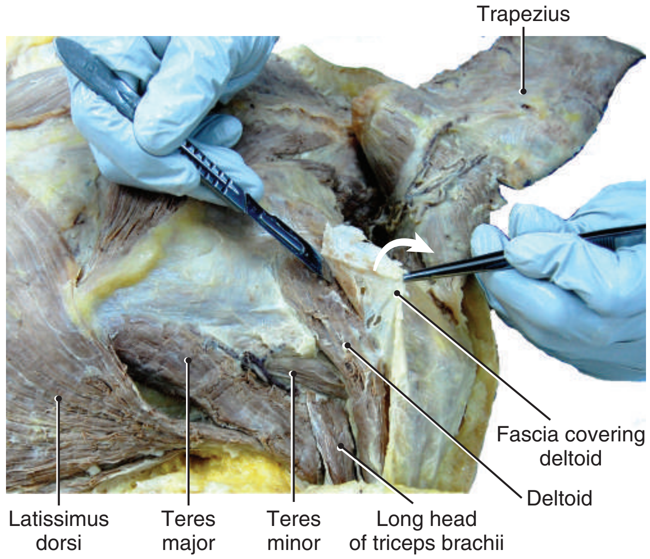
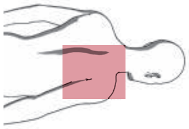

Trapezius
Fascia covering deltoid
Deltoid
Latissimus dorsi
Teres major
Teres minor
Long head of triceps brachii

Fig. 2.27 With scalpel, carefully detach deep fascia covering the posterior fibers of the deltoid muscle.



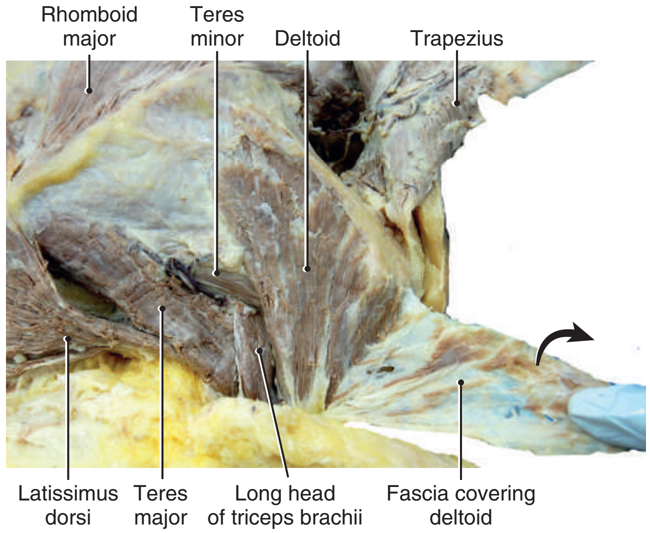
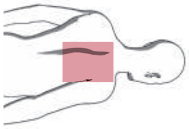
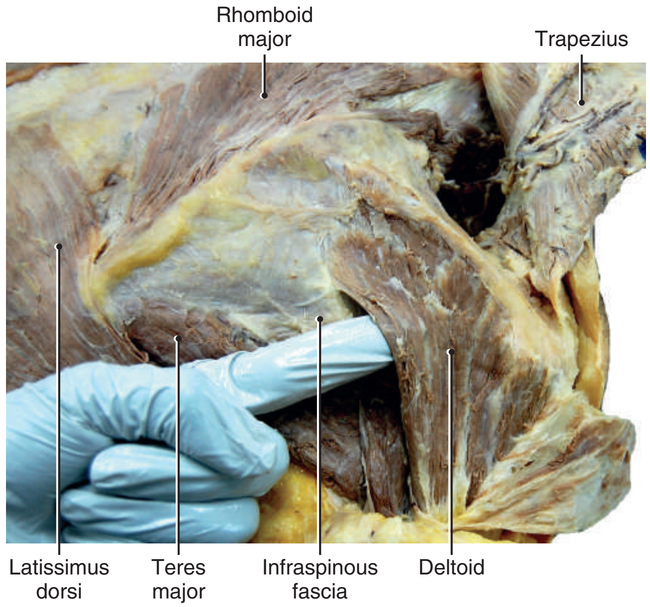

Rhomboid major
Teres minor
Deltoid
Trapezius
Latissimus dorsi
Teres major
Long head of triceps brachii
Fascia covering deltoid

Fig. 2.28 Deep fascia covering deltoid muscle is reflected, exposing deltoid muscle with its attachments onto spine of scapula.



- Insert your index finger under the deltoid muscle (Fig. 2.29).
- Using toothed forceps, scalpel, and scissors, reflect the posterior border of the deltoid laterally, separating it at its attachment on the spine of the scapular and acromion (Fig. 2.30).
- Continue reflecting the muscle laterally and posteriorly until the surgical neck of the humerus is visible, but leave the deltoid muscle attached to the deltoid tuberosity, the insertion of the muscle.


Rhomboid major
Trapezius
Latissimus dorsi
Teres major
Infraspinous fascia
Deltoid

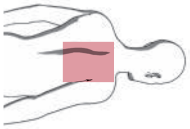
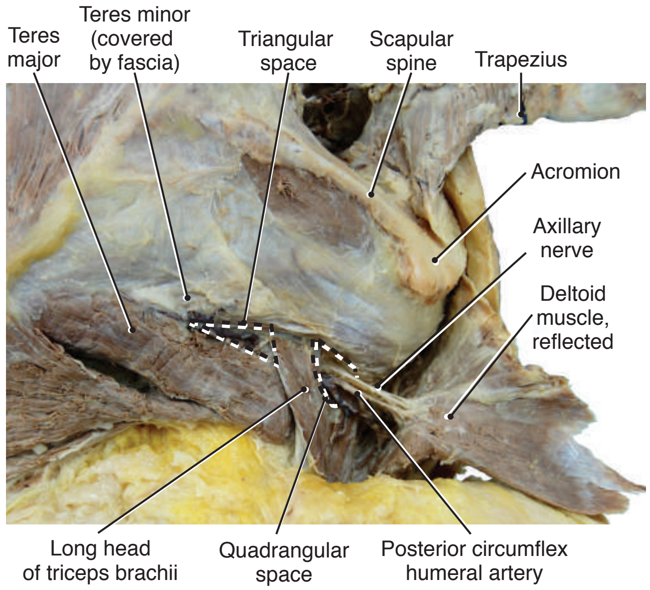


Fig. 2.29 Insert your index finger under deltoid muscle, and with a scalpel, detach its attachments to scapula.


Teres major
Teres minor (covered by fascia)
Triangular space
Scapular spine
Trapezius
Acromion
Axillary nerve
Deltoid muscle, reflected
Long head of triceps brachii
Quadrangular space
Posterior circumflex humeral artery

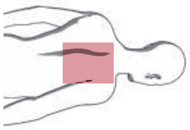


Fig. 2.30 View of internal surface of reflected deltoid muscle with posterior circumflex humeral artery and axillary nerve exposed. Note quadrangular and triangular spaces.

- Identify the quadrangular space bordered posteriorly by the teres major and minor muscles, long head of triceps brachii, and surgical neck of the humerus (see Fig. 2.30).
- Identify the axillary nerve as it appears posterior to the surgical neck of the humerus (see Fig. 2.30). The nerve is accompanied by the posterior circumflex humeral artery, a branch of the third portion of the axillary artery. The axillary nerve and posterior circumflex humeral artery appear in the field by emerging through the quadrangular space.
- Thoroughly clean the axillary nerve and the posterior circumflex humeral vessels at their entrance into the deltoid muscle behind the surgical neck of the humerus. Protect these as you clean connective tissue away from the muscles that help form the boundaries of the quadrangular space.

DISSECTION **TIP**

The axillary nerve typically branches off to several smaller branches and is usually superior to the posterior circumflex humeral artery.

- Identify the triangular space between the teres minor, teres major, and the long head of the triceps (see Fig. 2.30).
- Identify the scapular circumflex artery within the triangular space.

ANATOMY **NOTE**

This artery originates from the subscapular artery, one of the three branches of the third part of the axillary artery. The scapular circumflex artery branches to the overlying skin of the triangular space before turning around the lateral border of the scapula and passing deep to the infraspinatus muscle.

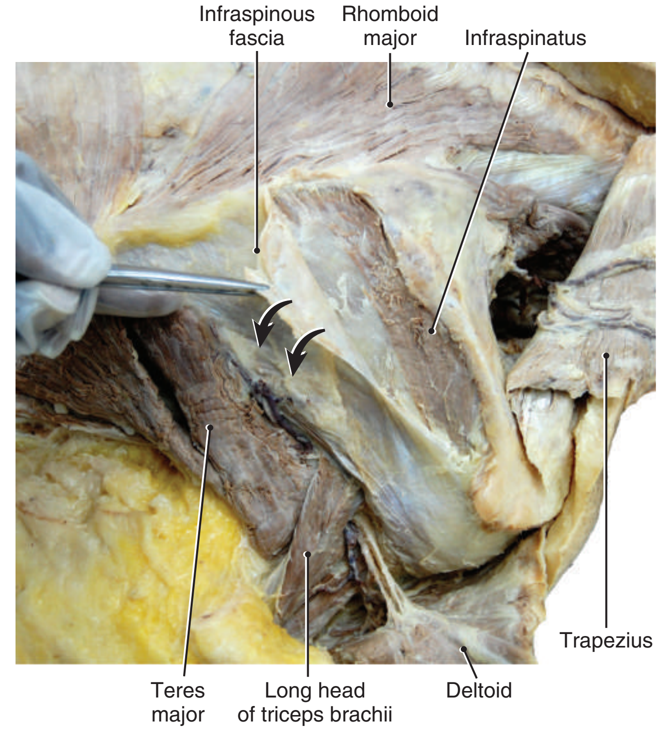
DISSECTION **TIP**

The scapular circumflex artery typically is located at the midpoint of the lateral border of the scapula (see Fig. 2.33).

ANATOMY **NOTE**

The infraspinous and supraspinous fasciae are attached to the scapula around the boundaries of the attachments of the infraspinatus and supraspinatus muscles, respectively.

- Identify the medial border of the infraspinatus muscle.
- With a scalpel, carefully detach deep fascia (infraspinous fascia) covering infraspinatus muscle (Fig. 2.31).


Infraspinous fascia
Rhomboid major
Infraspinatus
Trapezius
Teres major
Long head of triceps brachii
Deltoid

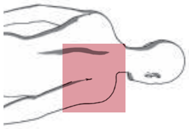
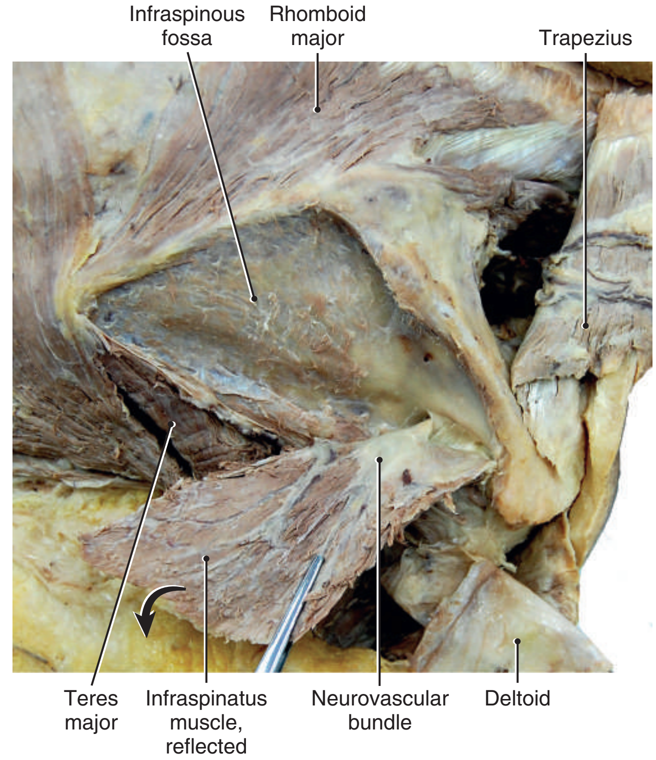


Fig. 2.31 With a scalpel, carefully detach deep fascia (infraspinous fascia) covering infraspinatus muscle.


Infraspinous fossa
Rhomboid major
Trapezius
Teres major
Infraspinatus muscle, reflected
Neurovascular bundle
Deltoid

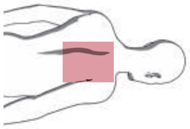
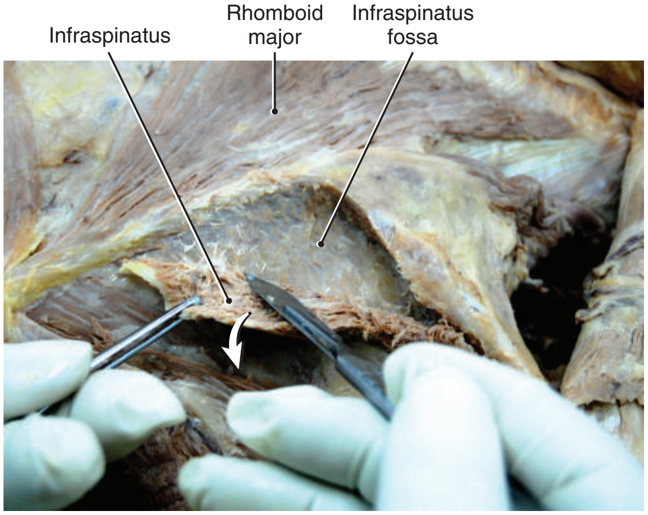


Fig. 2.33 View of infraspinous fossa with infraspinatus muscle reflected. Note the neurovascular bundle covered with connective tissue, which contains the suprascapular artery, vein, and nerve.


Infraspinatus
Rhomboid major
Infraspinatus fossa

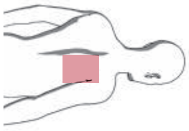


Fig. 2.32 With scalpel, carefully detach infraspinatus muscle from infraspinous fossa.

- Carefully detach infraspinatus muscle from infraspinous fossa (Fig. 2.32).
- Reflect the infraspinatus muscle laterally from the infraspinous fossa toward its humeral insertion (Fig. 2.33). Note the neurovascular bundle covered with connective tissue, which contains the suprascapular artery, vein, and nerve.
- Carefully separate the connective tissue over the neurovascular bundle to expose the suprascapular artery, nerve, and vein (Fig. 2.34).

ANATOMY **NOTE**

The suprascapular artery has a rich anastomosis with the scapular circumflex artery. This arrangement allows strong collateral arterial supply to develop between the subclavian artery and the third part of the axillary artery in the event of occlusion of the more proximal portions of the axillary artery.

- Identify and clean the supraspinatus muscle (Fig. 2.35).
- Beginning medially, reflect the muscle laterally from the supraspinous fossa far enough to expose the suprascapular nerve and artery.
- Identify the suprascapular artery and trace it from its origin to its crossing of the superior transverse scapular ligament to enter the supraspinous fossa, deep to the supraspinatus muscle (Fig. 2.36). Note the passage of the suprascapular nerve and vessels around the greater scapular notch, where they enter the infraspinatus muscle (Plate 2.2).

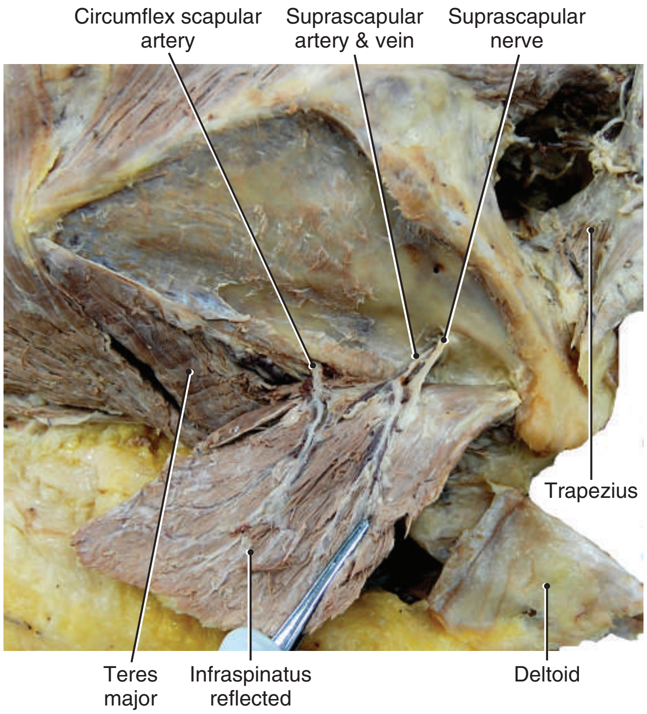
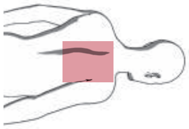

Circumflex scapular artery
Suprascapular artery & vein
Suprascapular nerve
Trapezius
Teres major
Infraspinatus reflected
Deltoid

Fig. 2.34 Connective tissue is dissected out, exposing the suprascapular artery, vein, and nerve, as well as the scapular circumflex artery.



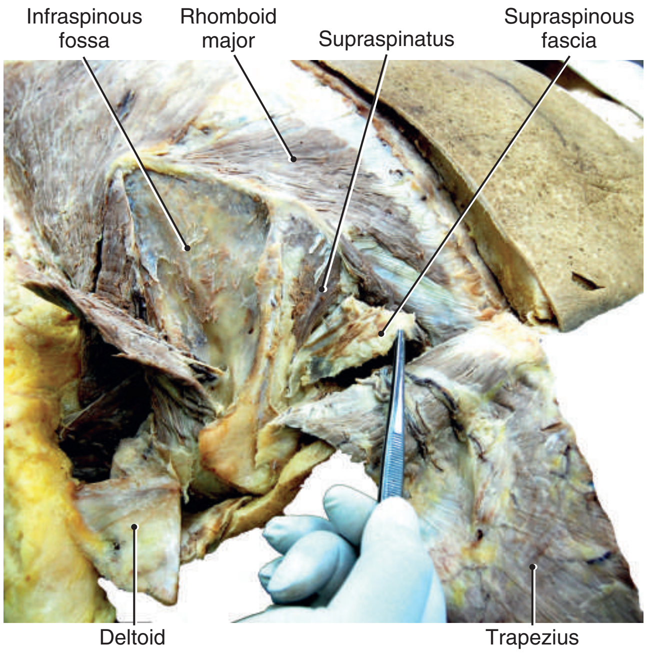
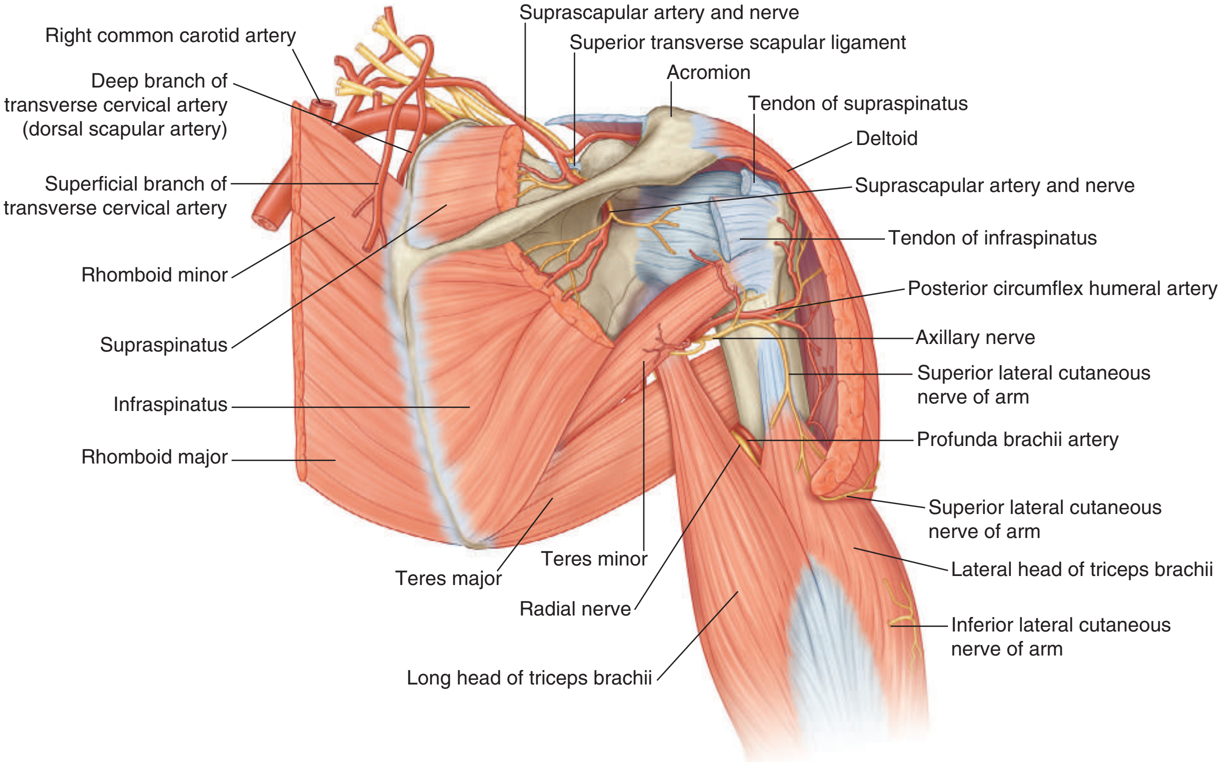

Infraspinous fossa
Rhomboid major
Supraspinatus
Supraspinous fascia
Deltoid
Trapezius

Fig. 2.35 Supraspinous fascia is reflected and the supraspinatus muscle exposed.


Right common carotid artery
Deep branch of transverse cervical artery (dorsal scapular artery)
Superficial branch of transverse cervical artery
Rhomboid minor
Supraspinatus
Infraspinatus
Rhomboid major
Teres major
Teres minor
Radial nerve
Long head of triceps brachii
Suprascapular artery and nerve
Superior transverse scapular ligament
Acromion
Tendon of supraspinatus
Deltoid
Suprascapular artery and nerve
Tendon of infraspinatus
Posterior circumflex humeral artery
Axillary nerve
Superior lateral cutaneous nerve of arm
Profunda brachii artery
Superior lateral cutaneous nerve of arm
Lateral head of triceps brachii
Inferior lateral cutaneous nerve of arm

Deep arteries and nerves of the shoulder (posterior view)

Plate 2.2 Collateral arterial supply between the subclavian artery and the third part of the axillary artery through anastomoses of the scapular circumflex artery and the suprascapular artery.

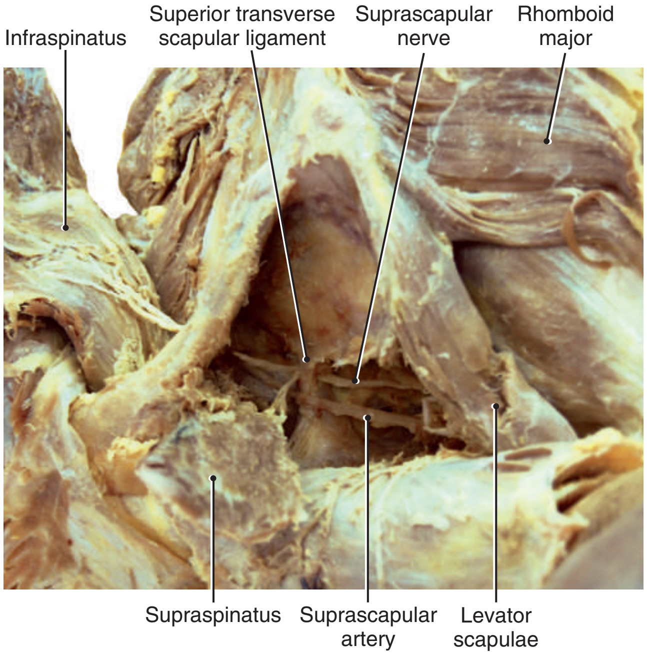
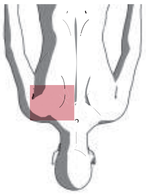

Infraspinatus
Superior transverse scapular ligament
Suprascapular nerve
Rhomboid major
Supraspinatus
Suprascapular artery
Levator scapulae

Fig. 2.36 View of internal surface of the supraspinous fossa. Notice suprascapular artery passing over superior transverse scapular ligament and suprascapular nerve underneath it.



SUPERFICIAL MUSCLES OF THE BACK: PART 2

- **Completely remove the deep fascia to expose the latissimus dorsi muscle.**
- **Make an incision through the aponeurosis of the latissimus dorsi muscle about ½ inch (1.25 cm) from the midline of the back, and cut its attachments to the crest of the ilium.**
- **Reflect the latissimus dorsi muscle superiorly and laterally (Fig. 2.37).**
- **Reflection of the trapezius and latissimus dorsi muscles exposes underlying intermediate extrinsic muscles of the back.**
- **Identify the serratus anterior and the serratus posterior inferior muscles (Fig. 2.38).**

DISSECTION **TIP**

If you do not exercise care, you will reflect the serratus posterior inferior muscle with the latissimus dorsi. The key to their separation lies in the recognition that although the serratus posterior inferior arises in common with part of the latissimus dorsi, the serratus inserts onto the lower ribs. These fibers can be observed as they diverge from those of the latissimus to pass to their insertion (Fig. 2.39).

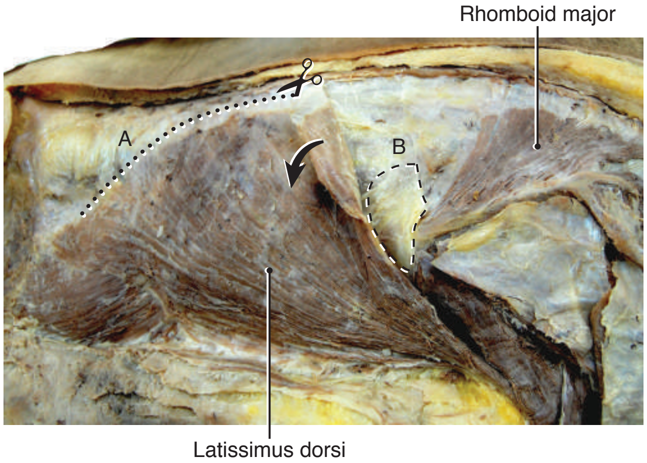

Rhomboid major
A
B
Latissimus dorsi

Fig. 2.37 *Dotted line A* shows location of incision through aponeurosis of latissimus dorsi muscle. *Dotted line B* shows area of connective/adipose tissue covering serratus anterior muscle.

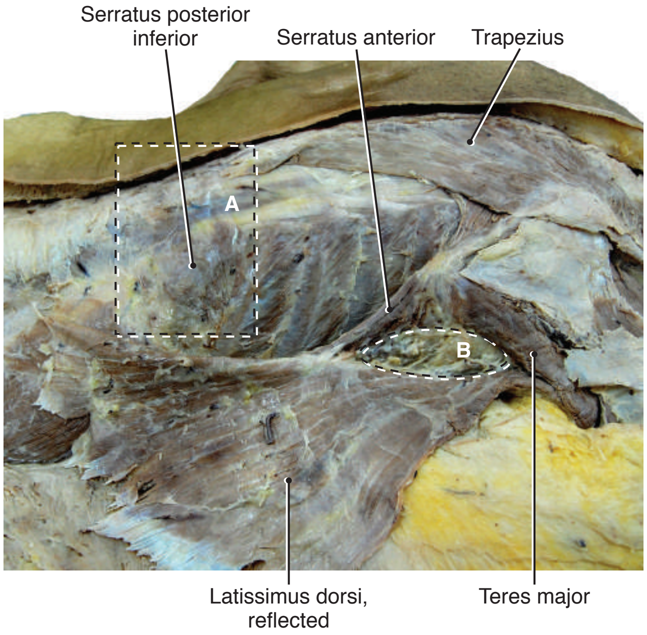

Serratus posterior inferior
Serratus anterior
Trapezius
A
B
Latissimus dorsi, reflected
Teres major

Fig. 2.38 Latissimus dorsi muscle is reflected, and *dotted outline A* shows serratus posterior inferior muscle. Connective/adipose tissue of Fig. 2.33 is removed and serratus anterior muscle exposed. *Dotted line B* shows second area of connective/adipose tissue between serratus anterior and latissimus dorsi muscles.

- **Pay special attention when removing the connective adipose tissue between the latissimus dorsi, serratus anterior, and teres major muscles so as not to injure the thoracodorsal artery and vein (Figs. 2.40 and 2.41).**
- **Cut the origin of the serratus posterior inferior muscle and reflect it toward its insertion.**

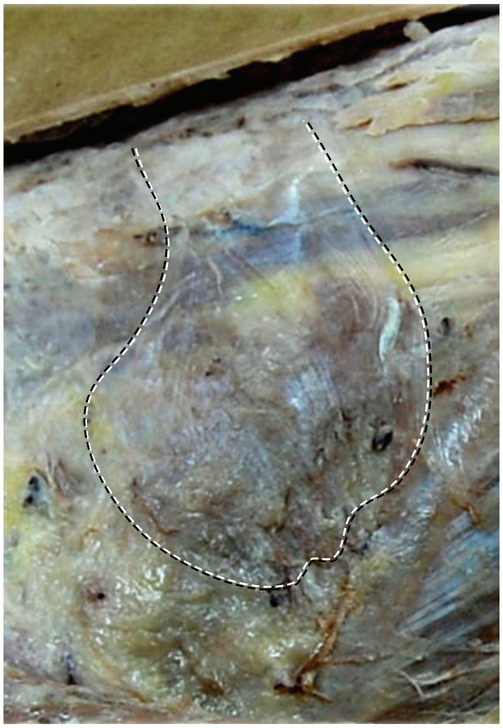


Fig. 2.39 *Dotted lines* show borders of serratus posterior inferior muscle.

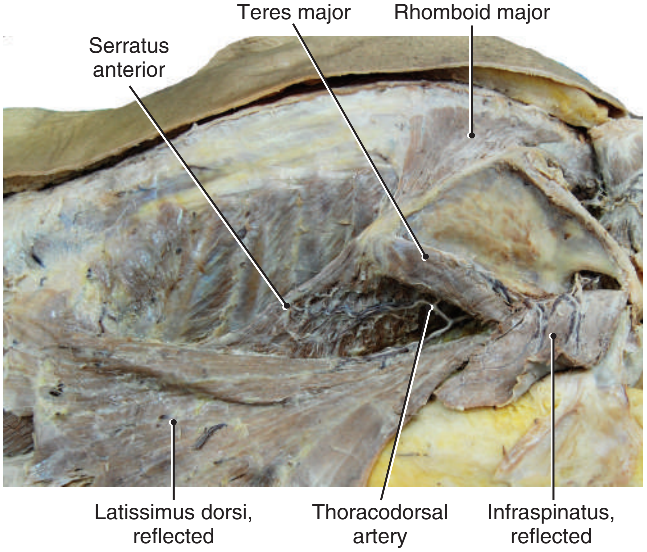

Teres major
Rhomboid major
Serratus anterior
Latissimus dorsi, reflected
Thoracodorsal artery
Infraspinatus, reflected

Fig. 2.40 View of the internal surface of the scapula and dorsal scapular artery traveling at the medial border of the scapula.

○ Make a longitudinal incision through the lumbar part of the thoracolumbar fascia near the midline. Then, by cutting its attachments to the underlying musculature, reflect this thick fascia/aponeurosis combination laterally far enough to expose the erector spinae muscle layer (Figs. 2.42 and 2.43).

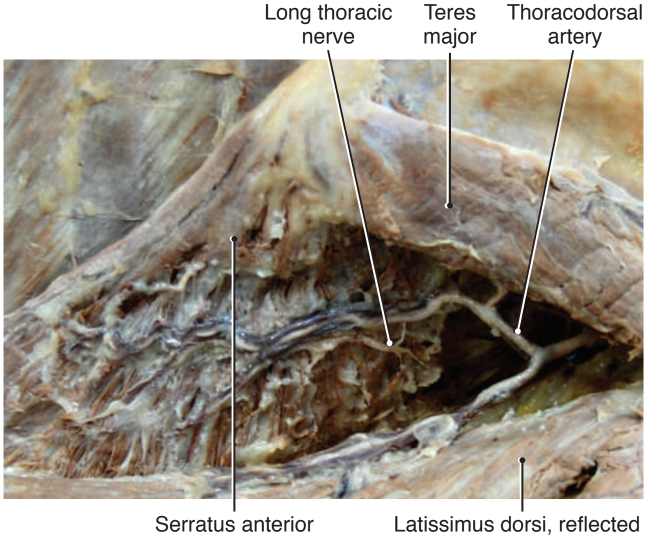
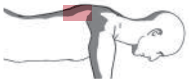

Long thoracic nerve
Teres major
Thoracodorsal artery
Serratus anterior
Latissimus dorsi, reflected

Fig. 2.41 Close-up view of space between teres major, serratus anterior, and latissimus dorsi muscles (area *B* in Fig. 2.38). Note the thoracodorsal artery and long thoracic nerve supplying the serratus anterior muscle.



DISSECTION **TIP**

The reflection of the thoracolumbar fascia is performed in the lumbar region only. For the thoracic region, it is unnecessary because the fascia is much thinner there. In this specimen, the fascia in the thoracic region was thick enough to be reflected (see Fig. 2.42).

○ Identify and separate the three longitudinally oriented columns of the erector spinae muscle: the spinalis, longissimus, and iliocostalis (Fig. 2.44).

ANATOMY **NOTE**

The spinalis is the more medial muscle; the longissimus is the longest muscle, extending to the neck; and the iliocostalis is the most lateral of the three muscles, attaching the iliac crest to the ribs.

DEEP MUSCLES OF THE BACK

○ To expose the deeper musculature, remove a block of the erector spinae muscle several inches long from the lower thoracic and upper lumbar region, and identify the transversospinalis musculature (Figs. 2.45 and 2.46). The transversospinalis muscles include the semispinalis, multifidus, and rotators.

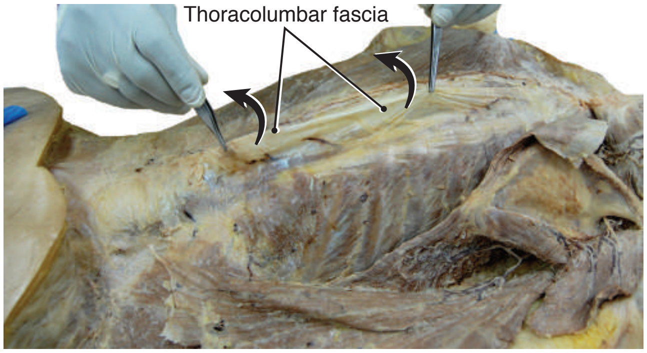

Thoracolumbar fascia

Fig. 2.42 Reflection of thoracolumbar fascia.

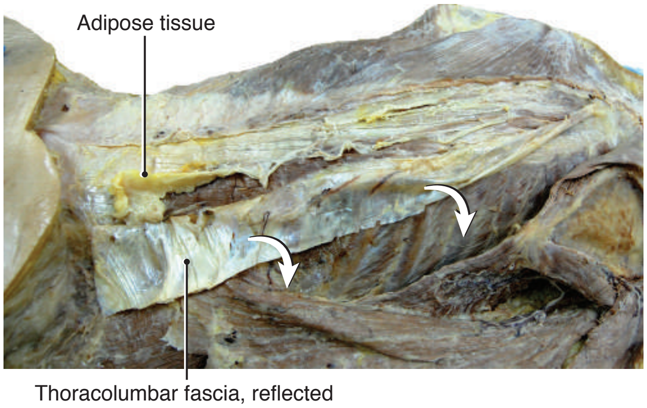

Adipose tissue
Thoracolumbar fascia, reflected

Fig. 2.43 Thoracolumbar fascia is reflected, and erector spinae muscle is exposed. Note adipose tissue overlying erector spinae. *Dotted line* represents longitudinal incision of thoracolumbar fascia from the midline.

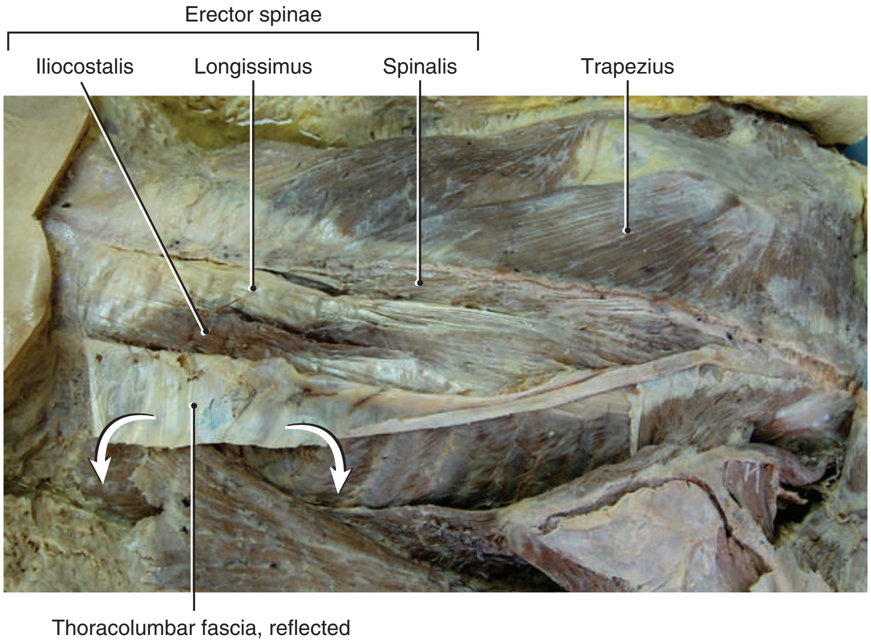

Erector spinae
Iliocostalis
Longissimus
Spinalis
Trapezius
Thoracolumbar fascia, reflected

Fig. 2.44 The thoracolumbar fascia is reflected, and the erector spinae muscle is exposed.

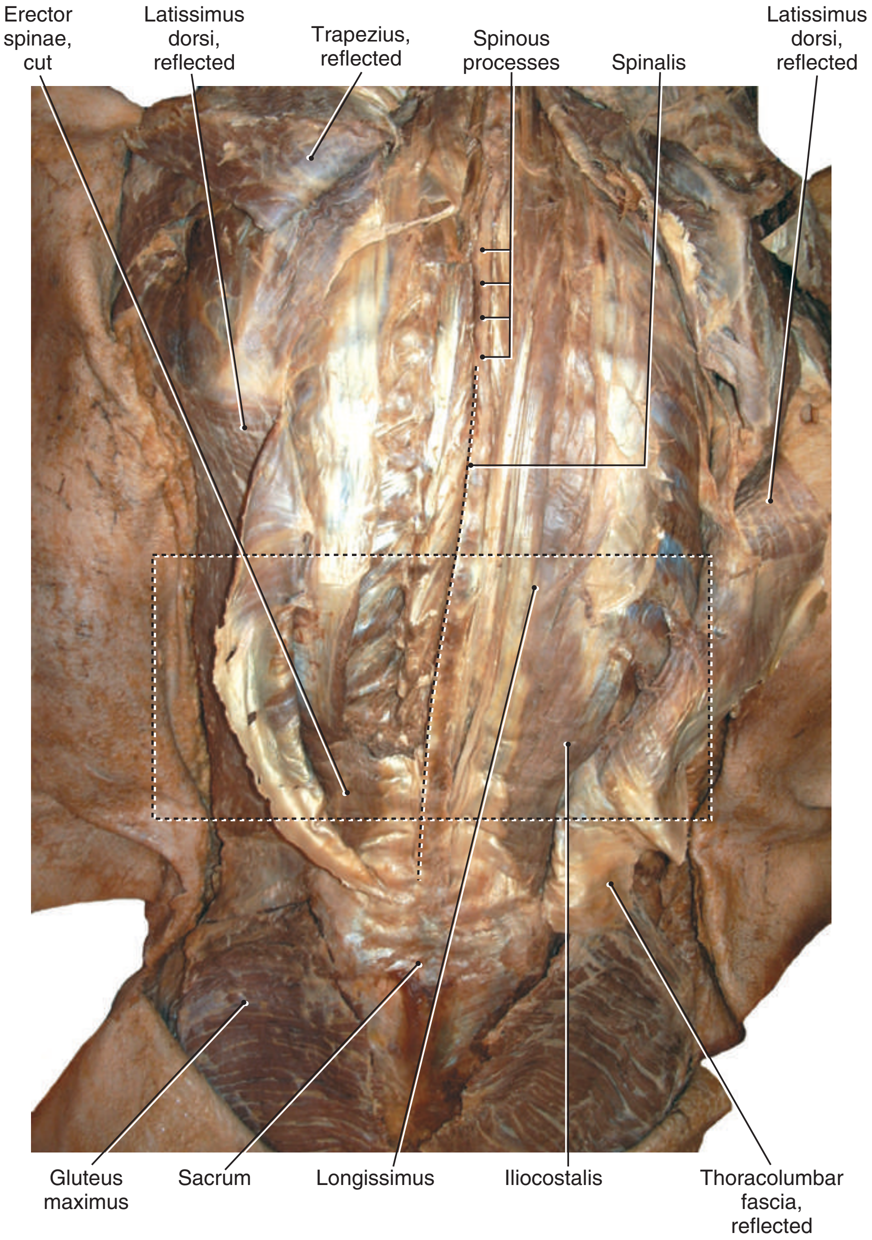

Erector spinae, cut
Latissimus dorsi, reflected
Trapezius, reflected
Spinous processes
Spinalis
Latissimus dorsi, reflected
Gluteus maximus
Sacrum
Longissimus
Iliocostalis
Thoracolumbar fascia, reflected

Fig. 2.45 The thoracolumbar fascia is reflected laterally, and the erector spinae muscle (spinalis, longissimus, iliocostalis) are exposed on the right. On the left, the erector spinae muscles are cut to expose the deeper muscles of back.

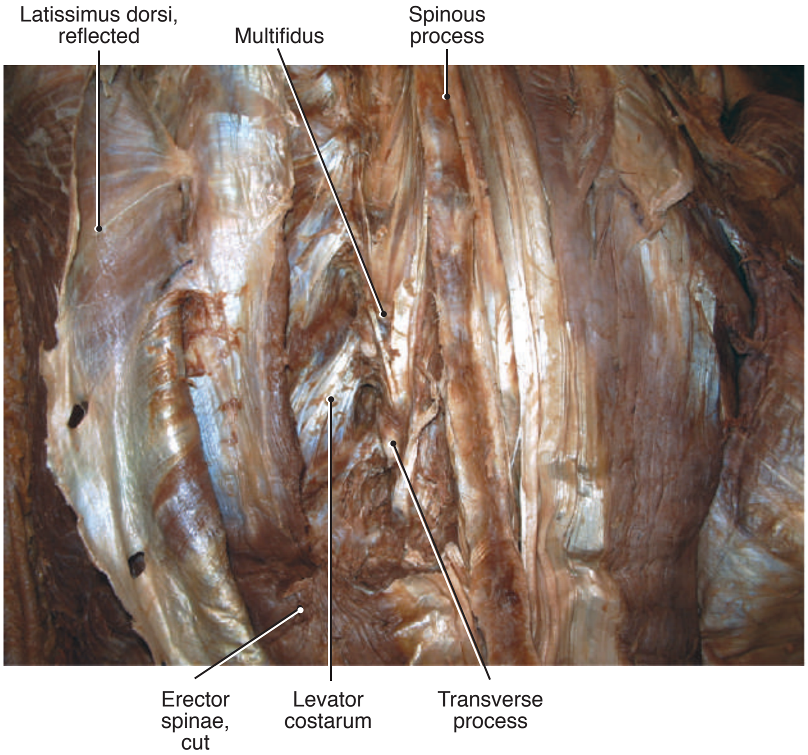
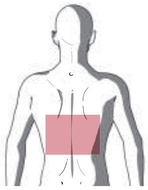

Latissimus dorsi, reflected
Multifidus
Spinous process
Erector spinae, cut
Levator costarum
Transverse process

Fig. 2.46 Multifidus and levator costarum muscles are exposed.



LABORATORY IDENTIFICATION CHECKLIST

OSTEOLOGY

- ☐ Skull and vertebrae
- ☐ Superior nuchal line
- ☐ External occipital protuberance
- ☐ Mastoid process
- ☐ Vertebra prominens (C7)
- ☐ Spinous processes of thoracic and lumbar vertebrae, and sacrum and coccyx

CLAVICLE

- ☐ Medial and lateral ends, body, and curvatures

SCAPULA

- ☐ Acromion
- ☐ Spine of scapula
- ☐ Medial or vertebral border
- ☐ Superior border
- ☐ Suprascapular notch
- ☐ Inferior angle
- ☐ Superior angle
- ☐ Lateral or axillary border
- ☐ Coracoid process

OTHER

- ☐ Iliac crests

MUSCLES

- ☐ Trapezius
- ☐ Latissimus dorsi
- ☐ Serratus posterior inferior
- ☐ Serratus posterior superior
- ☐ Levator scapulae
- ☐ Rhomboid minor
- ☐ Rhomboid major
- ☐ Deltoid
- ☐ Triceps brachii, long head
- ☐ Supraspinatus
- ☐ Infraspinatus
- ☐ Teres major
- ☐ Teres minor
- ☐ Transversospinalis
  - ☐ Semispinalis
  - ☐ Multifidus
  - ☐ Rotatores
- ☐ Semispinalis
- ☐ Splenius capitis
- ☐ Erector spinae
  - ☐ Spinalis
  - ☐ Longissimus
  - ☐ Iliocostalis

NERVES

- ☐ Greater occipital
- ☐ Accessory
- ☐ Dorsal scapular
- ☐ Suprascapular
- ☐ Axillary

FASCIAE

- ☐ Thoracolumbar
- ☐ Supraspinous/infraspinous

LIGAMENT

- ☐ Superior transverse scapular

ARTERIES

- ☐ Occipital
- ☐ Suprascapular
- ☐ Scapular circumflex
- ☐ Transverse cervical
- ☐ Dorsal scapular
- ☐ Posterior circumflex humeral

VEIN

- ☐ Transverse cervical

CHAPTER 3 SUBOCCIPITAL TRIANGLE AND SPINAL CORD

ATLAS REFERENCES

Netter: 170, 174–178, 184
McMinn: 94–99, 104, 105
Gray's Atlas: 20–32, 36–42, 399, 400

SUBOCCIPITAL TRIANGLE

- Make a midline skin incision from the spinous process of the 7th cervical vertebra (C7) to the external occipital protuberance (Fig. 3.1).
- At the level of the external occipital protuberance, make a horizontal skin incision connecting the right and left mastoid processes.
- Reflect the skin and the subcutaneous fat as one layer.
- Beneath the subcutaneous tissue, a connective tissue layer covers the upper portion of the trapezius muscle (Fig. 3.2); dissect away this layer and expose the trapezius (Fig. 3.3).
- While cleaning out the fascia that overlies the most cephalic portion of the trapezius muscle (see Fig. 2.10), look for the greater occipital nerve (Fig. 3.4).
- Also at this location, locate the occipital artery and preserve it as the trapezius is reflected.

ANATOMY **NOTE**

The greater occipital nerve usually can be found about 1 inch (2.5 cm) from the midline of the neck and 1 inch inferior to the superior nuchal line, as this nerve pierces the trapezius muscle (see Figs. 2.11 to 2.12).

DISSECTION **TIP**

Usually, the deep fascia over the trapezius muscle, below the superior nuchal line, is thick and difficult to cut until the C7 level. About 1 cm lateral to the midline, the 3rd occipital nerve (medial branch of dorsal ramus of C3 spinal nerve) is seen along the nuchal ligament (ligamentum nuchae) intermingled with the deep fascia over this area (see Figs. 3.3 and 3.4). Generally, the 3rd occipital nerve is very small and often is cut during routine dissections.

- Identify the greater occipital nerve and the 3rd occipital nerve, and preserve them after reflecting the trapezius away from its cranial and cervical attachments. Carefully reflect the trapezius muscle from its cranial and cervical attachments (Figs. 3.5 to 3.7).

DISSECTION **TIP**

The trapezius is thin at its cephalic and cervical attachments (see Fig. 3.6). Be careful during its reflection. While reflecting the trapezius up from its distal end, keep the scalpel blade facing downward toward the vertebrae, not upward, in order to prevent damage to the muscle.

- The small amount of connective tissue between the trapezius and splenius capitis muscles can be removed.
- At the lateral border of the splenius capitis, identify the lesser occipital nerve (see Fig. 3.7).
- Identify the splenius capitis and splenius cervicis muscles; divide them at their origins from the spines of the cervical and upper thoracic vertebrae and reflect them laterally, exposing the semispinalis capitis muscle (Figs. 3.8 through 3.10).
- Cut the attachment of the semispinalis capitis muscle from the skull and the ligamentum nuchae to reveal the suboccipital triangle. Preserve the greater occipital and lesser occipital nerves as the semispinalis muscle is reflected.

DISSECTION **TIP**

Make one small cut on the semispinalis capitis muscle medial to the greater and lesser occipital nerves (Fig. 3.11). In this way, the semispinalis capitis muscle easily can be reflected laterally without disturbing the course of the nerves (Fig. 3.12).

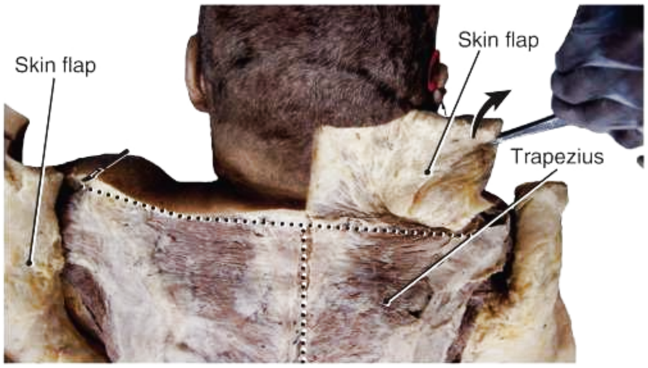
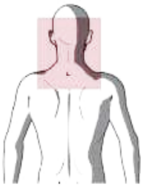


Fig. 3.1 Once the overlying skin is reflected, the deeper lying trapezius muscle is seen.



mebooksfree

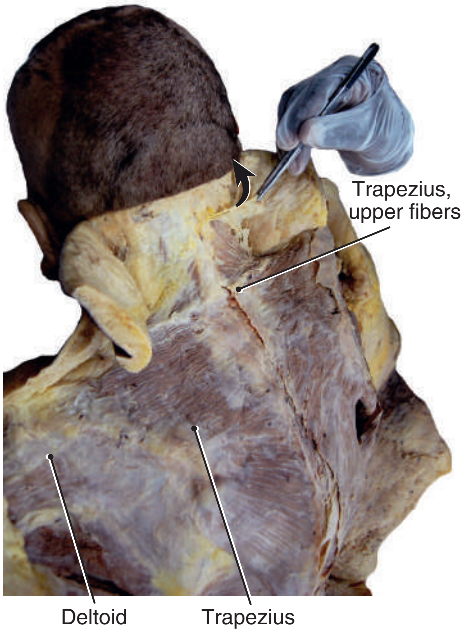

Trapezius, upper fibers
Deltoid
Trapezius

Fig. 3.2 Reflected skin and fascia revealing upper, middle, and lower fibers of the trapezius muscle.

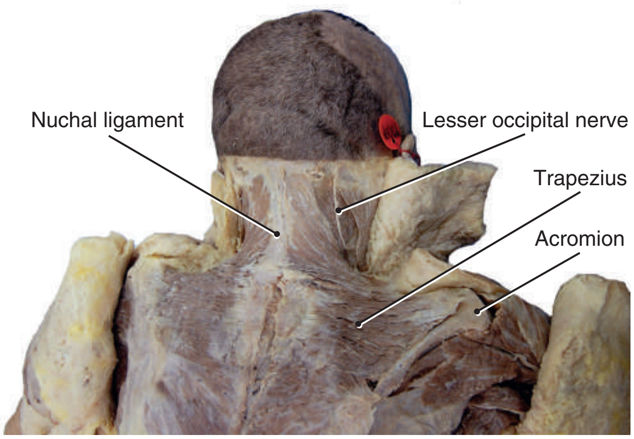

Nuchal ligament
Lesser occipital nerve
Trapezius
Acromion

Fig. 3.3 Superficial upper back and suboccipital regions: upper, middle, and lower fibers of trapezius muscle and nuchal ligament (ligamentum nuchae).

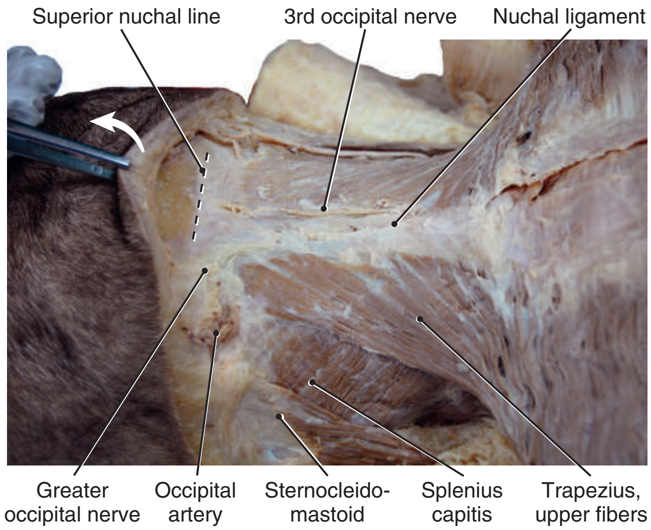
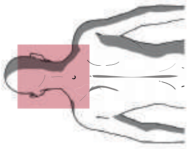

Superior nuchal line
3rd occipital nerve
Nuchal ligament
Greater occipital nerve
Occipital artery
Sternocleido-mastoid
Splenius capitis
Trapezius, upper fibers

Fig. 3.4 Structures superficial to suboccipital triangle: nuchal ligament, trapezius (upper fibers), splenius capitis, sternocleidomastoid, 3rd occipital nerve, and occipital artery.



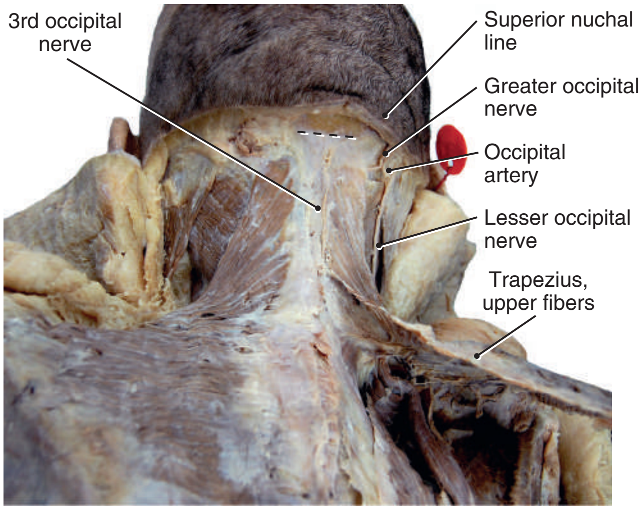
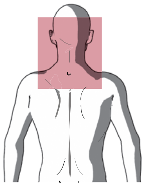
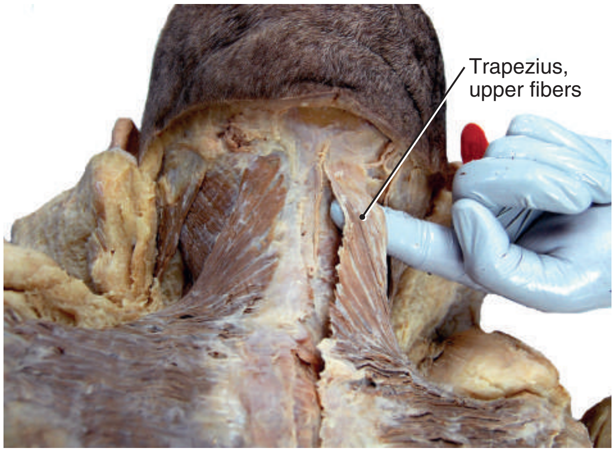

3rd occipital nerve
Superior nuchal line
Greater occipital nerve
Occipital artery
Lesser occipital nerve
Trapezius, upper fibers

Fig. 3.5 Initial reflection of the trapezius muscle.




Trapezius, upper fibers

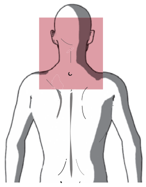
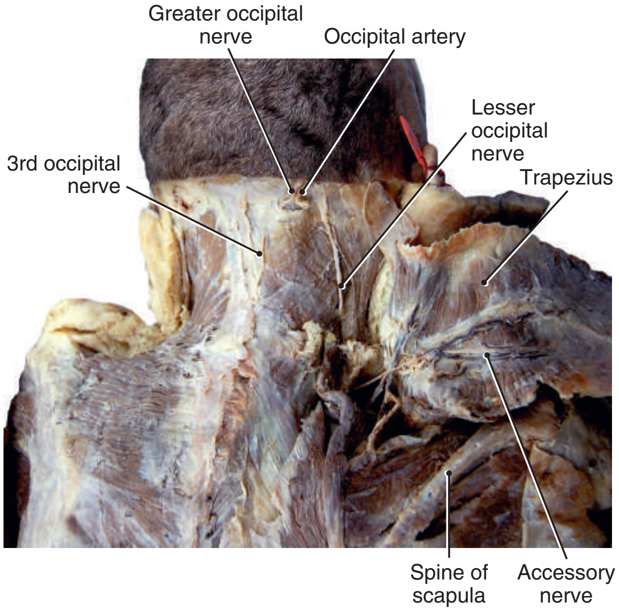


Fig. 3.6 Elevation of upper fibers of the trapezius muscle reflected away from the nuchal ligament.


Greater occipital nerve
Occipital artery
Lesser occipital nerve
3rd occipital nerve
Trapezius
Spine of scapula
Accessory nerve

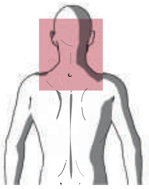
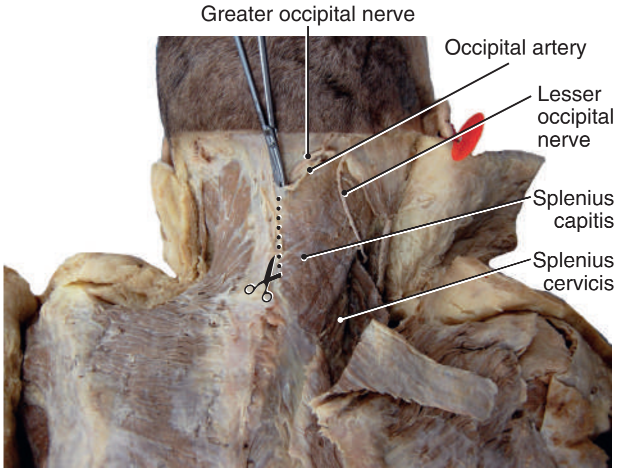


Fig. 3.7 Posterolateral view of superficial suboccipital region with reflected trapezius muscle and its associated neurovascular bundle pasted on its undersurface.


Greater occipital nerve
Occipital artery
Lesser occipital nerve
Splenius capitis
Splenius cervicis

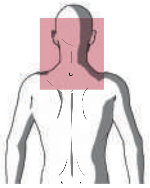
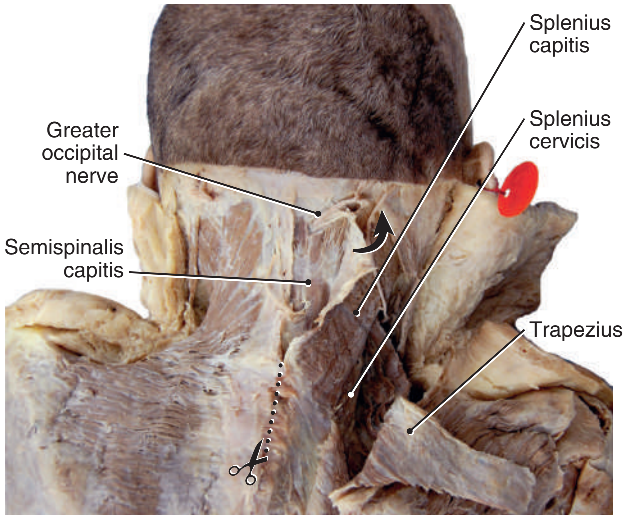


Fig. 3.8 Insert the scissors deep to the splenius capitis muscle at the midline and continue the incision inferiorly along the nuchal ligament.


Splenius capitis
Splenius cervicis
Greater occipital nerve
Semispinalis capitis
Trapezius

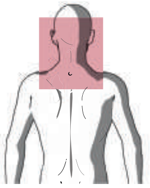


Fig. 3.9 Reflect splenius capitis laterally, and continue incision toward 1st thoracic vertebra (T1) level.

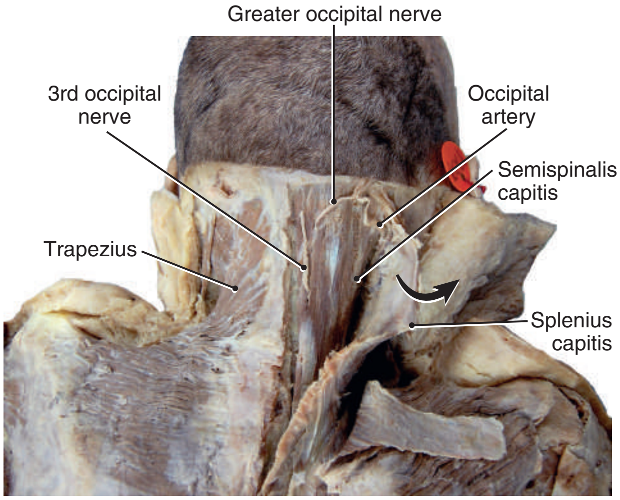
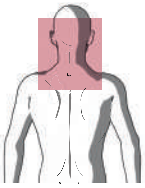

Greater occipital nerve
3rd occipital nerve
Occipital artery
Semispinalis capitis
Trapezius
Splenius capitis

Fig. 3.10 Complete reflection of the splenius capitis muscle laterally.



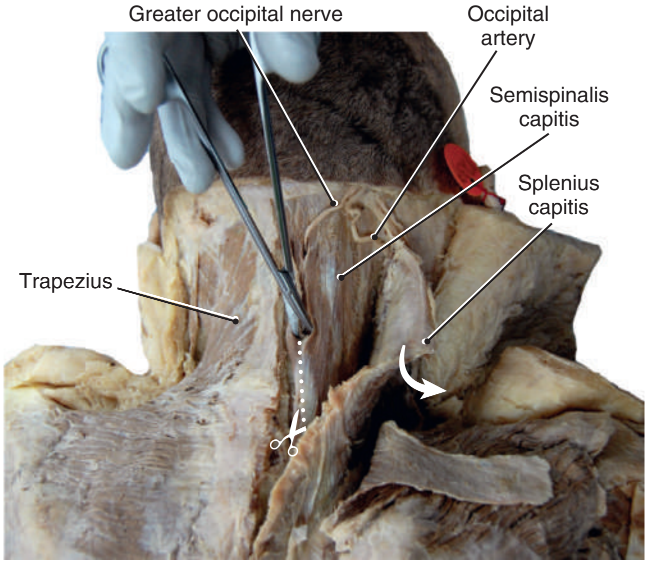
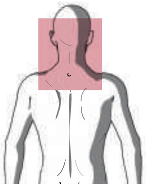

Greater occipital nerve
Occipital artery
Semispinalis capitis
Splenius capitis
Trapezius

Fig. 3.11 Make an incision into the semispinalis capitis muscle near the midline down to approximately the T1 level. Preserve the greater and 3rd occipital nerves.



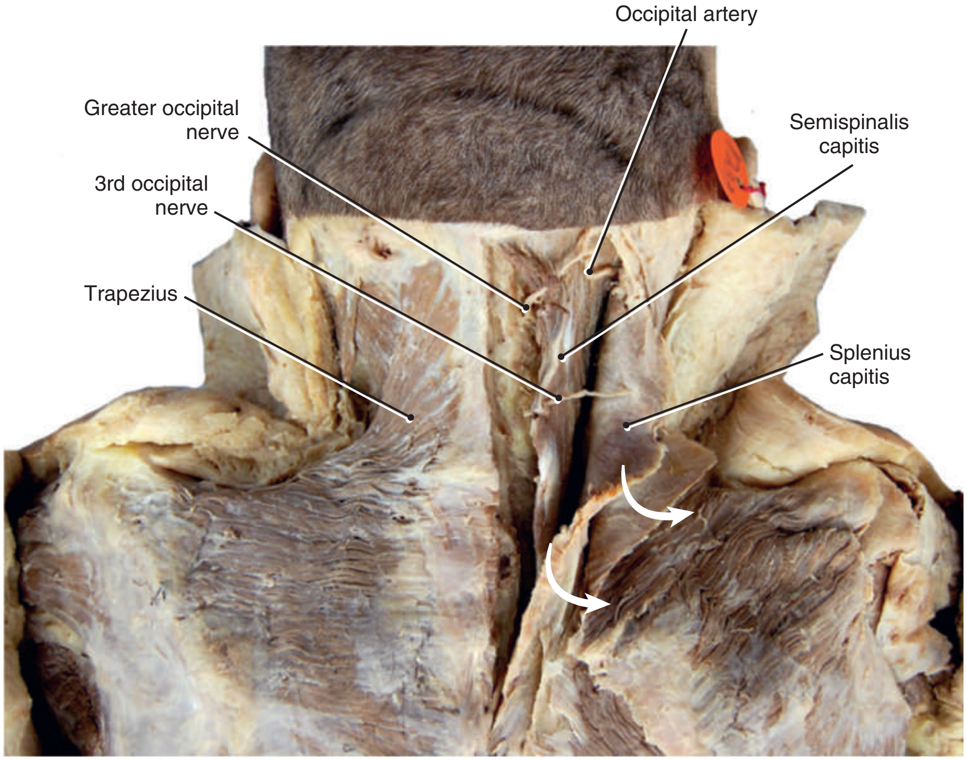
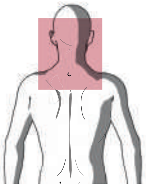

Occipital artery
Greater occipital nerve
Semispinalis capitis
3rd occipital nerve
Trapezius
Splenius capitis

Fig. 3.12 Reflected trapezius, splenius capitis, and semispinalis capitis muscles.



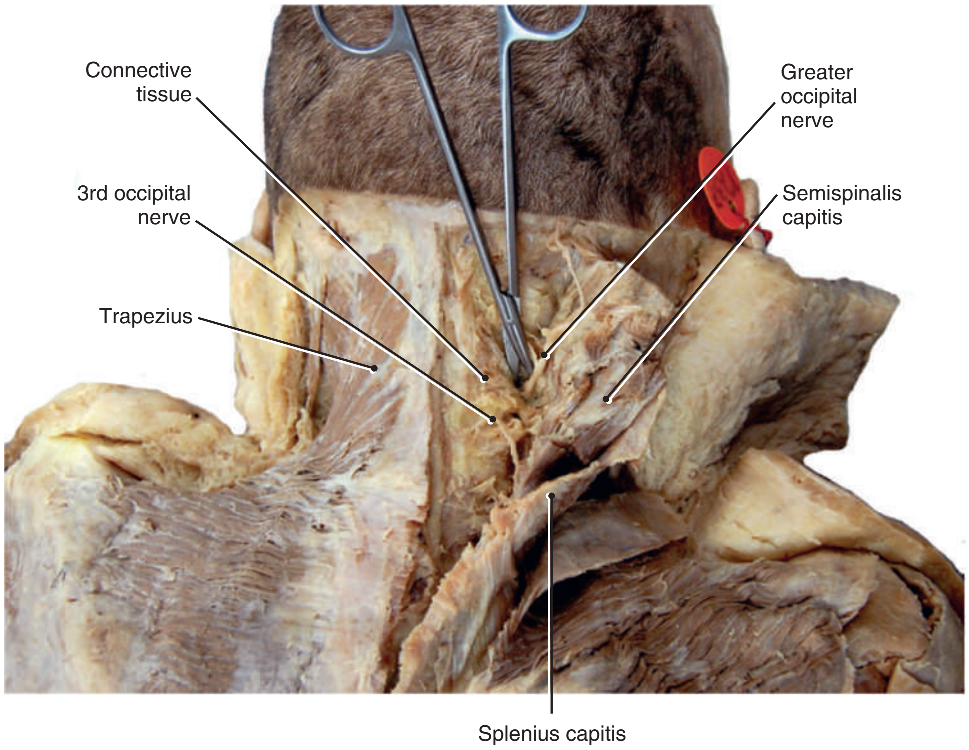
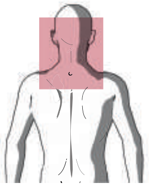

Connective tissue
3rd occipital nerve
Trapezius
Greater occipital nerve
Semispinalis capitis
Splenius capitis

Fig. 3.13 Remove fat and connective tissues from around the greater and 3rd occipital nerves. Use the separation technique with your scissors.



- **Trace the occipital nerves down through the underlying fat and connective tissue, clearing away the connective tissue using the "separating scissors technique" (Fig. 3.13).**

DISSECTION **TIP**

Even after the semispinalis capitis muscle is reflected, generally the boundaries or contents of the suboccipital triangle are not immediately apparent and are hidden by overlying connective tissue. Remove these tissues carefully (Figs. 3.14 and 3.15).

- **Place the tip of your finger into the suboccipital triangle to locate the posterior arch of the atlas.**
- **After removal of the connective tissue, identify the muscles that form the sides of the suboccipital triangle: inferior capitis oblique, superior capitis oblique, and rectus capitis posterior major (Fig. 3.16) (Plate 3.1).**

ANATOMY **NOTE**

The rectus capitis posterior major is found superficial to the rectus capitis posterior minor. Although the rectus capitis posterior minor is considered a "suboccipital" muscle, it does not contribute to the margins of the suboccipital triangle.

DISSECTION **TIP**

Use fine scissors and take your time to expose and clearly demonstrate the vertebral artery. Besides the connective tissue over the vertebral artery, a rich venous plexus is also present. Clean away the connective tissue and venous plexus. You will see only the posterior wall of the vertebral artery.

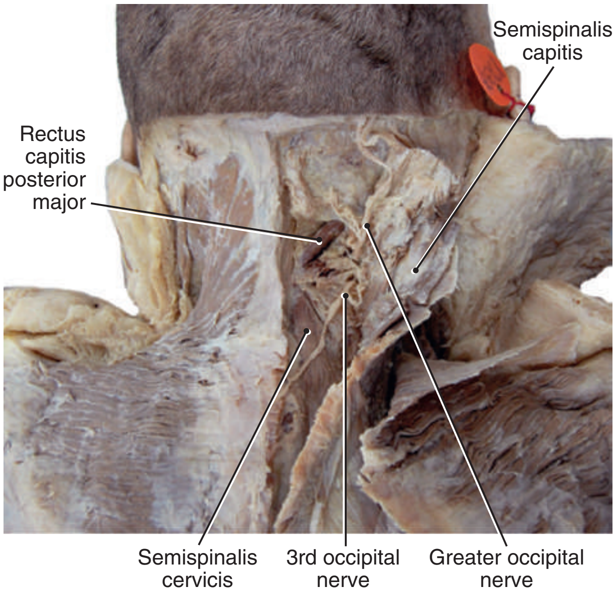
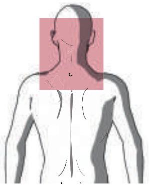
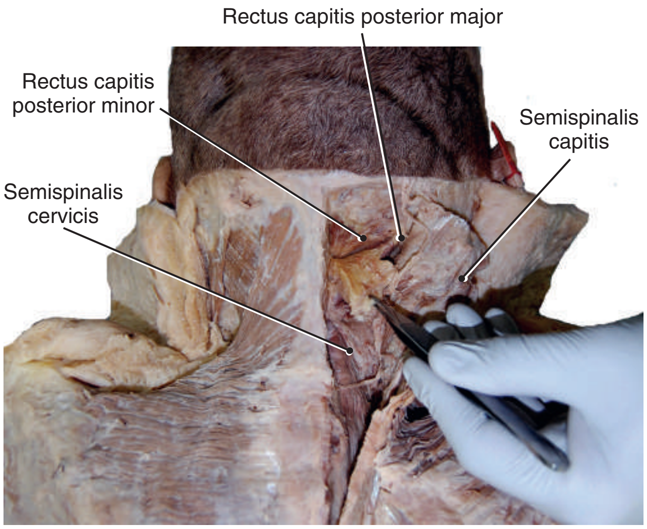

Semispinalis capitis
Rectus capitis posterior major
Semispinalis cervicis
3rd occipital nerve
Greater occipital nerve

Fig. 3.14 Dissection of suboccipital triangle demonstrating the rectus capitis posterior major muscle and greater and 3rd occipital nerves. Remove all fat and connective tissue.




Rectus capitis posterior major
Rectus capitis posterior minor
Semispinalis capitis
Semispinalis cervicis

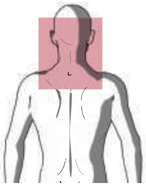
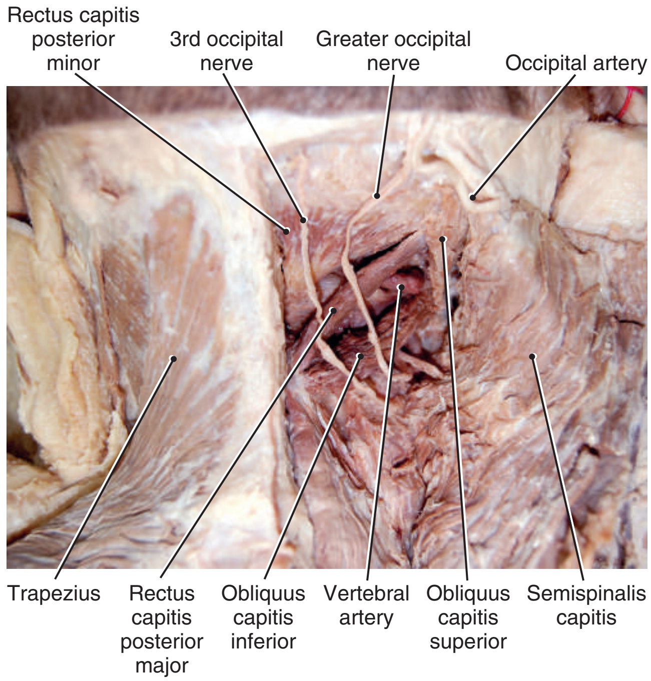


Fig. 3.15 Dissection of suboccipital triangle revealing surrounding muscles, including the rectus capitis posterior major and minor and semispinalis capitis muscles.


Rectus capitis posterior minor
3rd occipital nerve
Greater occipital nerve
Occipital artery
Trapezius
Rectus capitis posterior major
Obliquus capitis inferior
Vertebral artery
Obliquus capitis superior
Semispinalis capitis

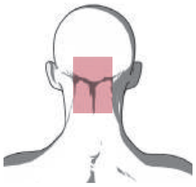


Fig. 3.16 Dissection of the suboccipital triangle highlighting borders and contents.

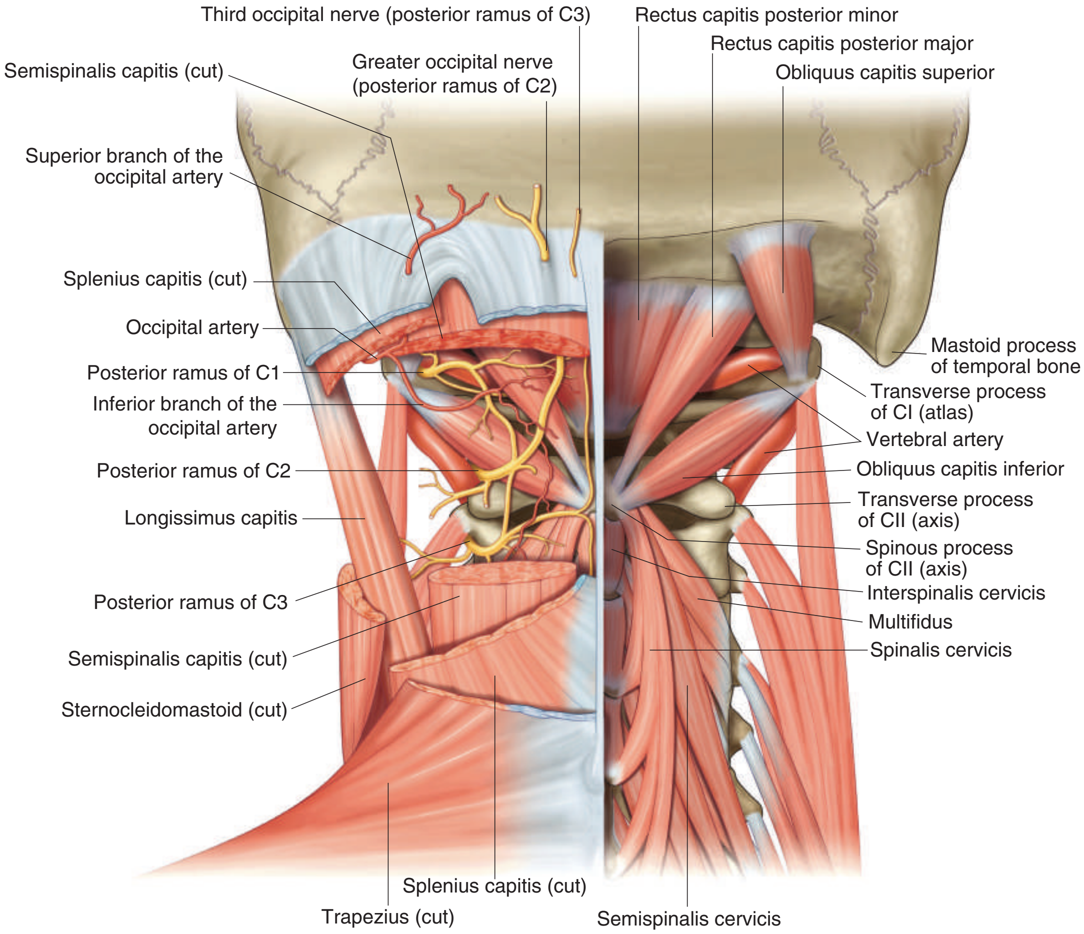

Third occipital nerve (posterior ramus of C3)
Rectus capitis posterior minor
Rectus capitis posterior major
Obliquus capitis superior
Semispinalis capitis (cut)
Greater occipital nerve (posterior ramus of C2)
Superior branch of the occipital artery
Splenius capitis (cut)
Occipital artery
Posterior ramus of C1
Inferior branch of the occipital artery
Posterior ramus of C2
Longissimus capitis
Posterior ramus of C3
Semispinalis capitis (cut)
Sternocleidomastoid (cut)
Mastoid process of temporal bone
Transverse process of CI (atlas)
Vertebral artery
Obliquus capitis inferior
Transverse process of CII (axis)
Spinous process of CII (axis)
Interspinalis cervicis
Multifidus
Spinalis cervicis
Splenius capitis (cut)
Trapezius (cut)
Semispinalis cervicis

Plate 3.1 The suboccipital triangle and associated structures.

- Expose the posterior arch of the atlas, and identify a tough connective tissue layer joining the posterior arch of the atlas to the skull, the posterior atlanto-occipital membrane. Clean the loose connective tissue away from the arch and expose the vertebral artery, which lies in the sulcus of the posterior arch of the atlas. Between the sulcus of the posterior arch and the vertebral artery, identify the suboccipital nerve, which innervates the suboccipital muscles and overlying semispinalis capitis muscle (Fig. 3.17).
- Using a scalpel, cut the rectus capitis posterior major and inferior capitis oblique muscles from the spinous process of the axis, and reflect them laterally (Fig. 3.18).
- Note the exit of the greater occipital nerve emerging from even deeper tough connective tissue (Fig. 3.19).
- Remove this connective tissue surrounding the greater occipital nerve, and expose its exit from the dura mater (Fig. 3.20).
- Retract the rectus capitis posterior minor superiorly, and expose the dorsal root ganglion of the 2nd cervical (C2) spinal nerve (Fig. 3.21).

LAMINECTOMY

- In preparation for the laminectomy, reflect or cut away the muscles of the back from the spines and transverse processes of the vertebrae as completely as possible using a scalpel, scissors, and chisel (Fig. 3.22).
- Clean away as much as possible all of the intrinsic muscles of the back from the laminae of the lower

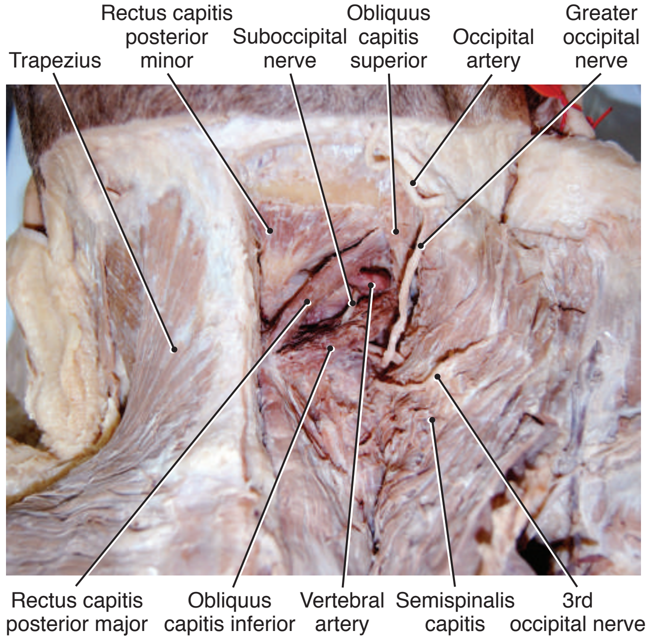
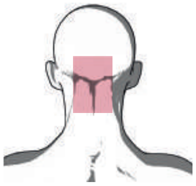

Trapezius
Rectus capitis posterior minor
Suboccipital nerve
Obliquus capitis superior
Occipital artery
Greater occipital nerve
Rectus capitis posterior major
Obliquus capitis inferior
Vertebral artery
Semispinalis capitis
3rd occipital nerve

Fig. 3.17 Suboccipital triangle borders (rectus capitis posterior major, superior and inferior capitis oblique muscles) and contents (vertebral artery, suboccipital nerve).



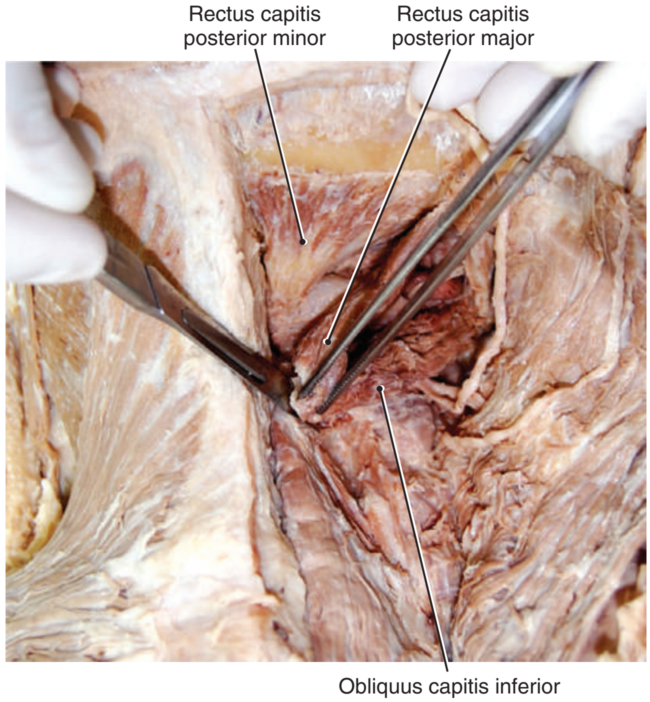
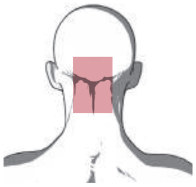

Rectus capitis posterior minor
Rectus capitis posterior major
Obliquus capitis inferior

Fig. 3.18 Dissection of suboccipital triangle, reflecting rectus capitis posterior major and obliquus capitis inferior muscles laterally.



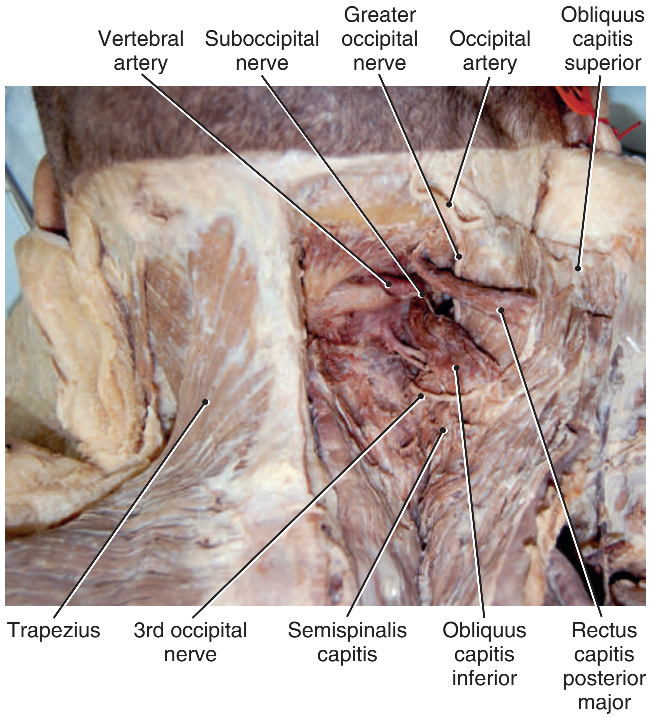
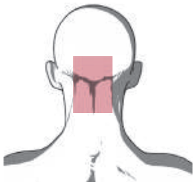

Vertebral artery
Suboccipital nerve
Greater occipital nerve
Occipital artery
Obliquus capitis superior
Trapezius
3rd occipital nerve
Semispinalis capitis
Obliquus capitis inferior
Rectus capitis posterior major

Fig. 3.19 Dissection of suboccipital triangle illustrating the obliquus capitis inferior and rectus capitis posterior major muscles, and revealing suboccipital nerve and vertebral artery.



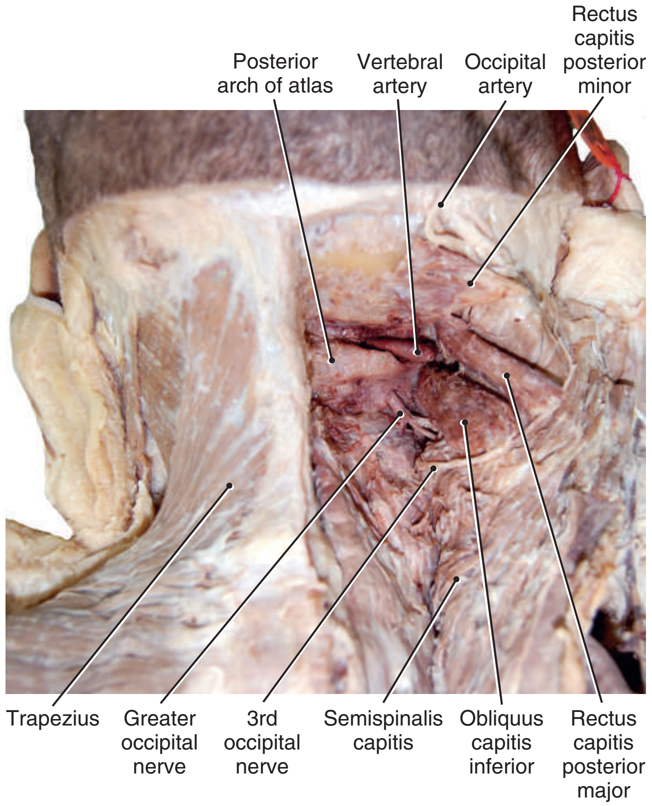
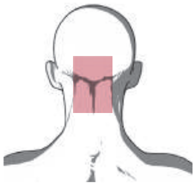

Posterior arch of atlas
Vertebral artery
Occipital artery
Rectus capitis posterior minor
Trapezius
Greater occipital nerve
3rd occipital nerve
Semispinalis capitis
Obliquus capitis inferior
Rectus capitis posterior major

Fig. 3.20 Dissection of suboccipital triangle, with reflected rectus capitis posterior minor exposing posterior arch of atlas.



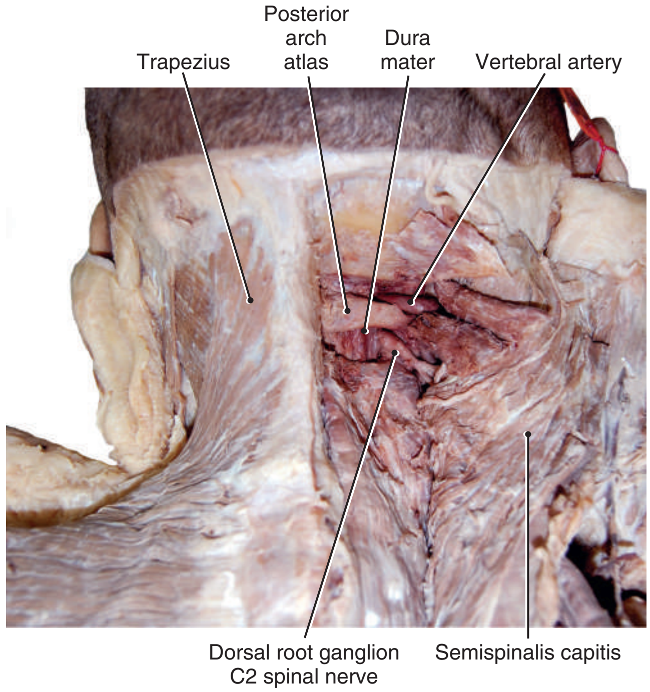
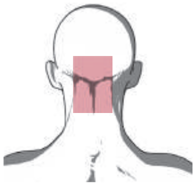

Trapezius
Posterior arch atlas
Dura mater
Vertebral artery
Dorsal root ganglion C2 spinal nerve
Semispinalis capitis

Fig. 3.21 Dissection of suboccipital triangle exposing dura mater of spinal cord, dorsal root ganglion, vertebral artery, and posterior arch of atlas.



cervical, thoracic, and upper lumbar regions (Fig. 3.23).

- With a bone saw or chisel and mallet, cut through the laminae longitudinally from the lower cervical to the lower lumbar regions (Figs. 3.24 through Fig. 3.26).
- Angle the saw or chisel laterally.

DISSECTION **TIP**

If using a chisel and mallet, perform the surface fracturing technique. Short tapping blows of the mallet are used until the lamina is felt to fracture. Do not allow the chisel to be driven too deeply, or injury to the spinal cord or its rootlets will occur.

- Direct the blade of the saw or chisel anteromedially to avoid cutting the spinal nerves (see Fig. 3.25) (Plate 3.2).
- Complete the dissection bilaterally (see Fig. 3.26).
- Using toothed forceps, gently lift spinous process–lamina unit away from spinal canal, revealing dura mater, dorsal root ganglia, and spinal cord (Fig. 3.27).
- Remove the spinous process–lamina unit from the lumbar region, exposing dura mater (Fig. 3.28).

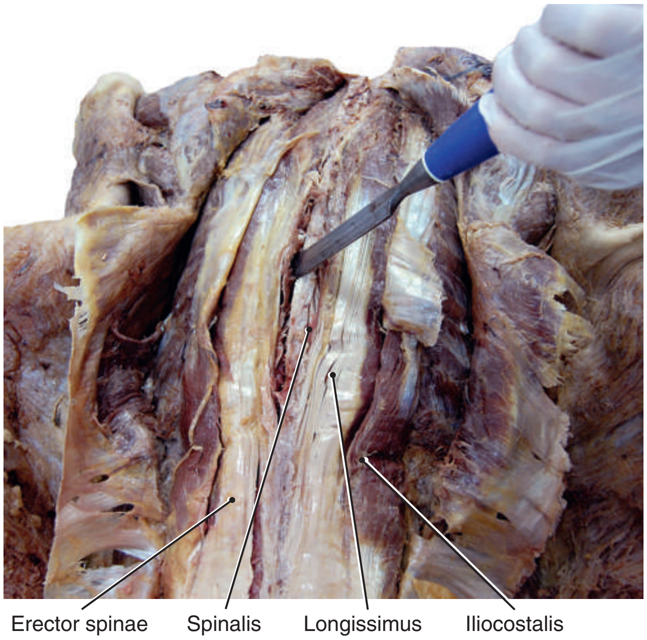
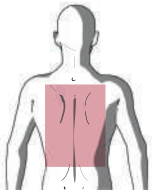

Erector spinae
Spinalis
Longissimus
Iliocostalis

Fig. 3.22 Superficial and intermediate muscles of back region reflected, revealing superficial layer of deep or native back muscles (erector spinae: spinalis, longissimus, iliocostalis).



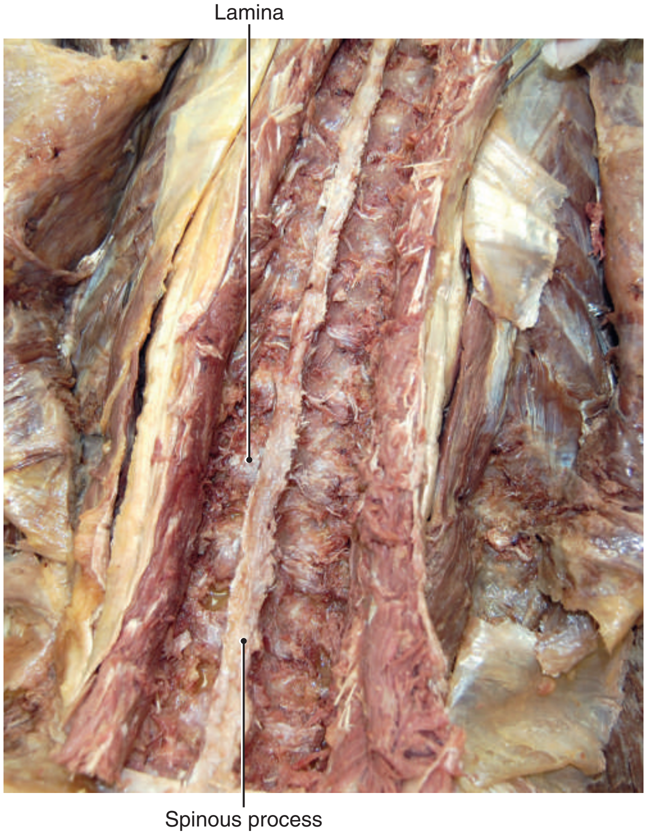
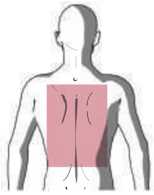

Lamina
Spinous process

Fig. 3.23 After removal of all muscles from the paraspinous region, the spinous processes and laminae are seen.



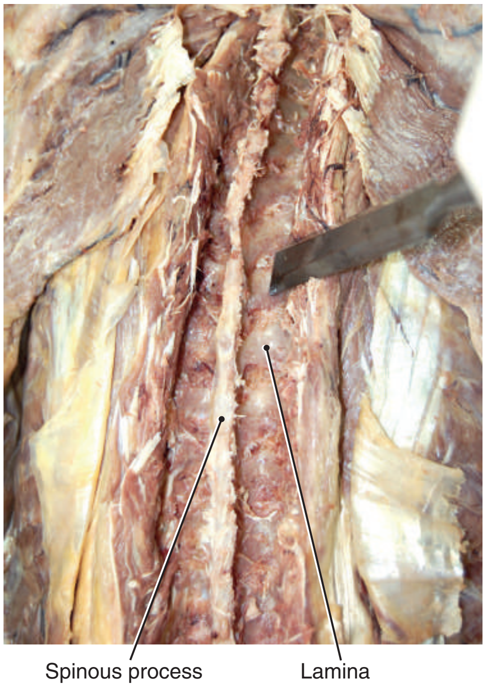
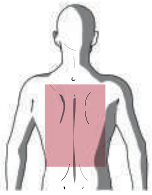

Spinous process
Lamina

Fig. 3.24 The chisel is placed flat onto each lamina and angled away from the midline.



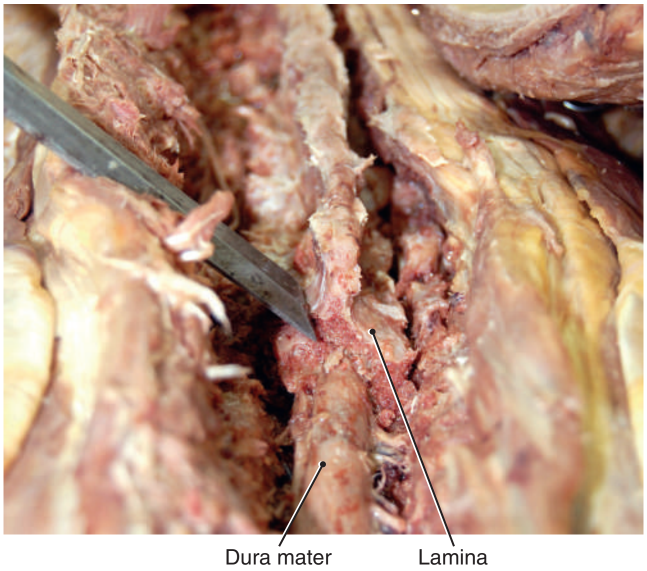
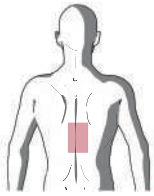

Dura mater
Lamina

Fig. 3.25 Direct blade of saw or chisel anteromedially to avoid cutting spinal nerves.



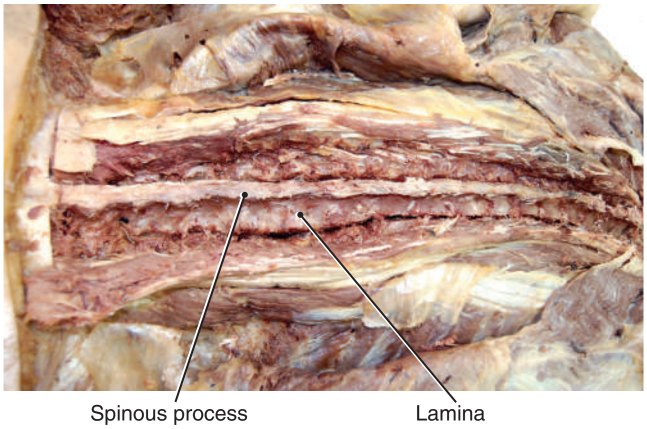
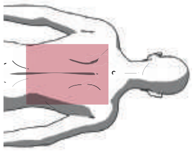

Spinous process
Lamina

Fig. 3.26 Bilateral dissection through laminae of vertebrae using chisel and mallet technique to reveal dura mater and spinal cord (Stryker-type electric saw also can be used).



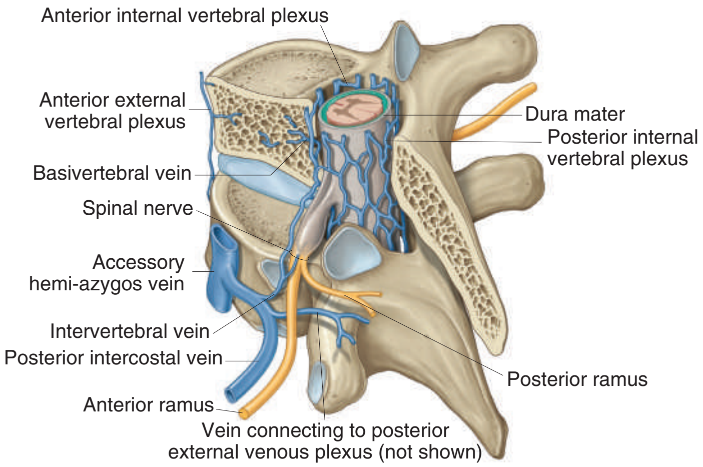

Anterior internal vertebral plexus
Anterior external vertebral plexus
Basivertebral vein
Spinal nerve
Accessory hemi-azygos vein
Intervertebral vein
Posterior intercostal vein
Anterior ramus
Vein connecting to posterior external venous plexus (not shown)
Dura mater
Posterior internal vertebral plexus
Posterior ramus

Plate 3.2 A lateral view of the hemisected vertebra exposing the spinal cord.

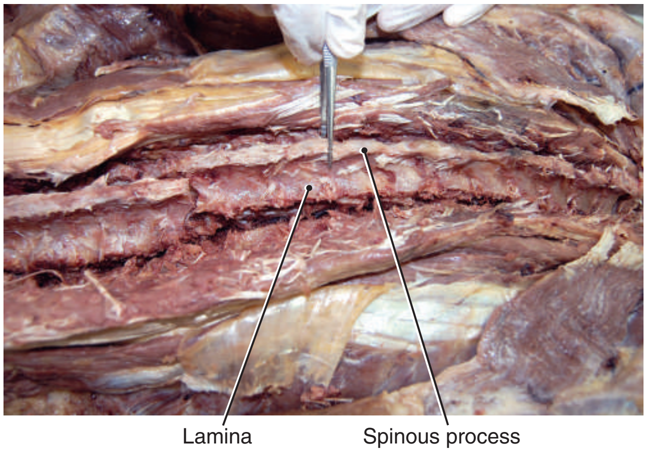
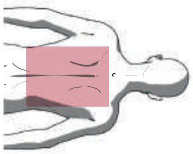

Lamina
Spinous process

Fig. 3.27 Using toothed forceps, gently lift spinous process–lamina unit away from spinal canal, revealing dura mater, dorsal root ganglia, and spinal cord.



DISSECTION **TIP**

To facilitate the process, several laminae can be removed together as a block (see Figs. 3.26 to 3.28). After excision of the vertebral laminae and spinous processes, the vertebral canal may not be exposed widely enough for clear visualization of its contents. If this is the case, remove additional bone as necessary with bone rongeurs or with a mallet and chisel. Exercise particular care in the regions of the intervertebral foramina to avoid cutting or tearing away the spinal nerve rootlets. Sharply pointed edges of bone may be present in the dissection field after the laminectomy is completed. Identify any sharp spicules and remove them to avoid injuries to your hands.

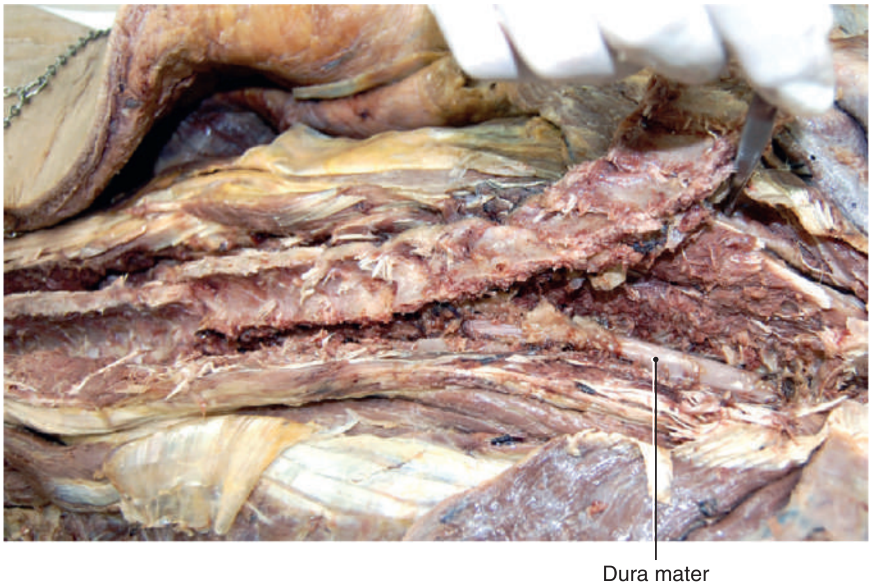
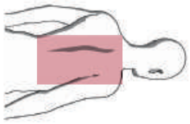


Fig. 3.28 Removal of spinous process–lamina unit from lumbar region, exposing dura mater.



- Remove the spinous processes and the laminae en bloc from the spinal canal (Fig. 3.29).
- Note the contents of the spinal canal: the epidural fat and the vertebral venous plexus of Batson (Fig. 3.30).
- Remove the fat and the venous plexus from the epidural space to expose the dura mater. Lift a part of the dura in the midline, and make a small, slit-like incision with scissors or a scalpel (Fig. 3.31).
- Continue the midline incision throughout the entire length of the dura mater (Fig. 3.32).
- If possible, avoid incising the underlying arachnoid layer by lifting and maintaining tension on the dura mater. Reflect the dura laterally to expose the contents of the dural sac. If the incision in the dura is made successfully, the arachnoid will appear as a thin, almost transparent layer (see Fig. 3.32).

DISSECTION **TIP**

Sometimes, arachnoid calcifications (plaques) may be present (Fig. 3.33). These are usually incidental findings and have been attributed to trauma, myelography, subarachnoid hemorrhage (see Fig. 3.32), and spinal anesthesia.

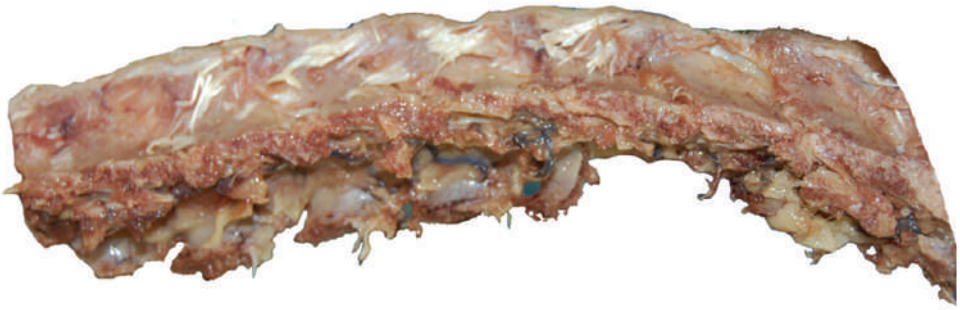


Fig. 3.29 Section of spinous process–lamina unit removed from vertebral column.

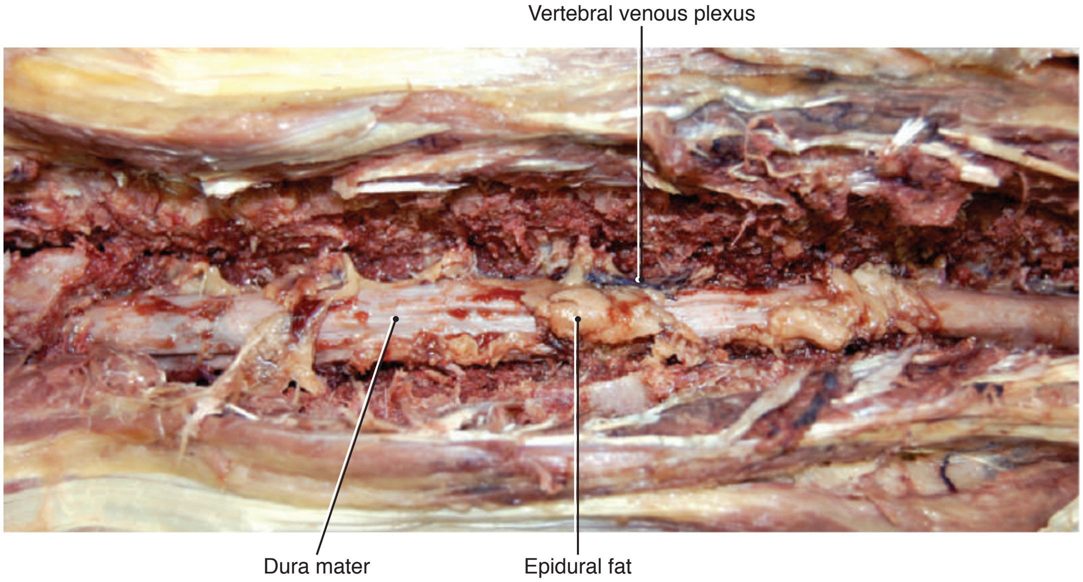
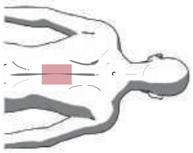


Fig. 3.30 Spinous process–lamina unit removed to expose epidural fat, dura mater, and vertebral venous plexus.



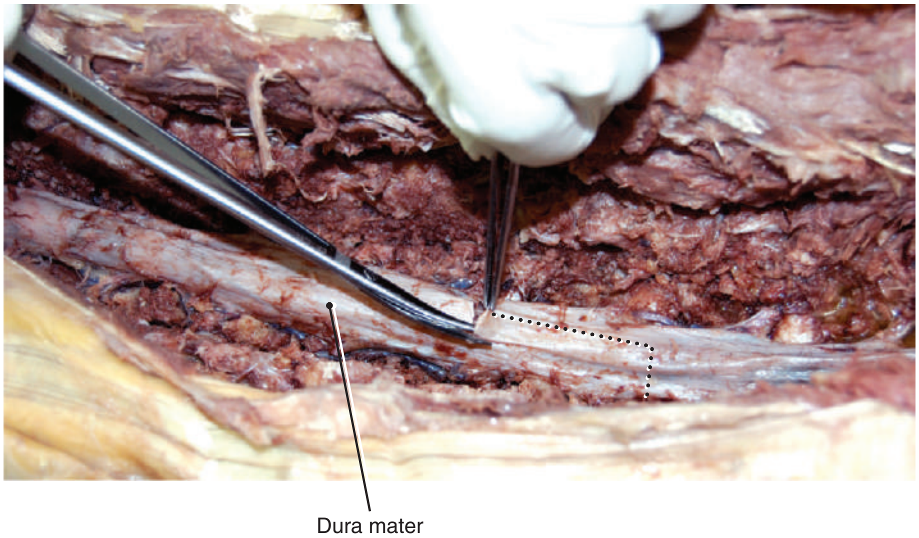
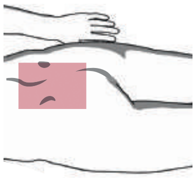


Fig. 3.31 Spinous process–lamina unit removed from lumbar region, revealing dura mater covering spinal cord and cauda equina. Elevate dura mater while making the transverse cut.



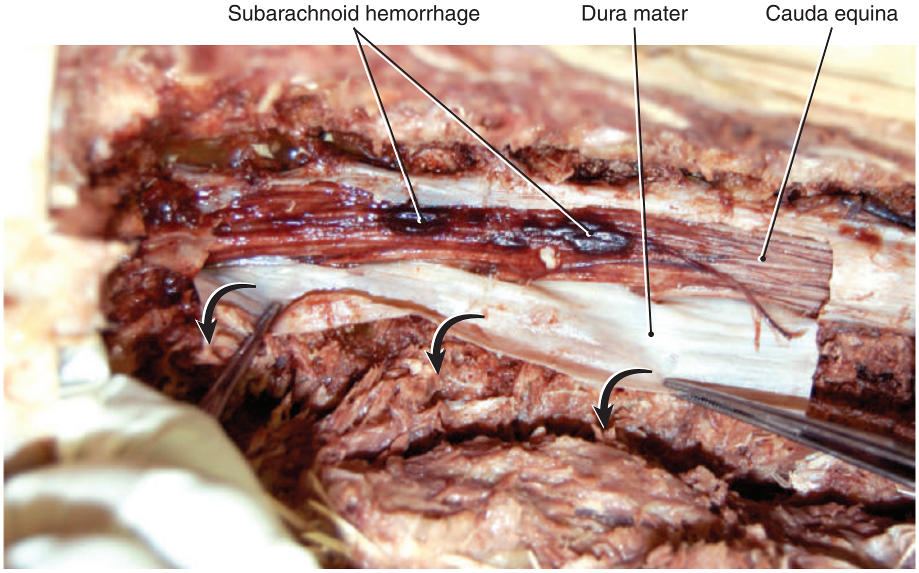
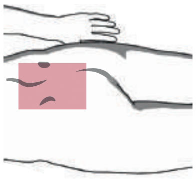

Subarachnoid hemorrhage
Dura mater
Cauda equina

Fig. 3.32 Transverse and vertical incisions reflecting dura mater, revealing cauda equina and subarachnoid hemorrhage.



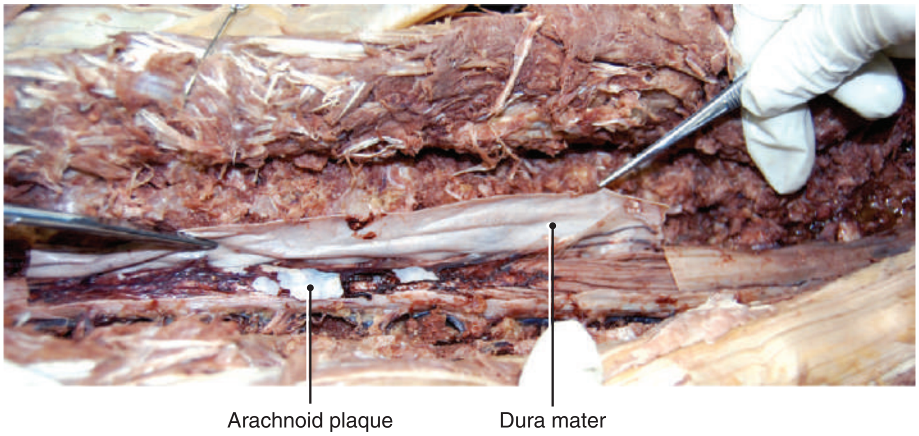
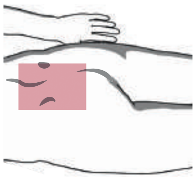

Arachnoid plaque
Dura mater

Fig. 3.33 Transverse and vertical incisions reflecting dura mater, revealing arachnoid plaque among cauda equina.



- Identify the spinal cord and its covering of pia mater. Observe the beginning of the filum terminale at its origin from the conus medullaris, the terminal part of the spinal cord. Note the cluster of nerve roots on either side of the conus medullaris, the *cauda equina* (Fig. 3.34; see also Figs. 3.31, 3.32, and 3.38).
- Transect and remove the spinal cord with its dural covering (Fig. 3.35).
- Look for the tooth-like denticulate ligaments on each side of the spinal cord, lifting the cord carefully with forceps for inspection. These projections occur at the level of each vertebra, from the occipital bone to the last thoracic spinal nerve. The denticulate ligaments pierce the arachnoid mater to attach to the dura mater (Figs. 3.36 and 3.37).
- Identify the posterior longitudinal ligament on the vertebral bodies after the removal of the spinal cord and dura mater (Fig. 3.38).

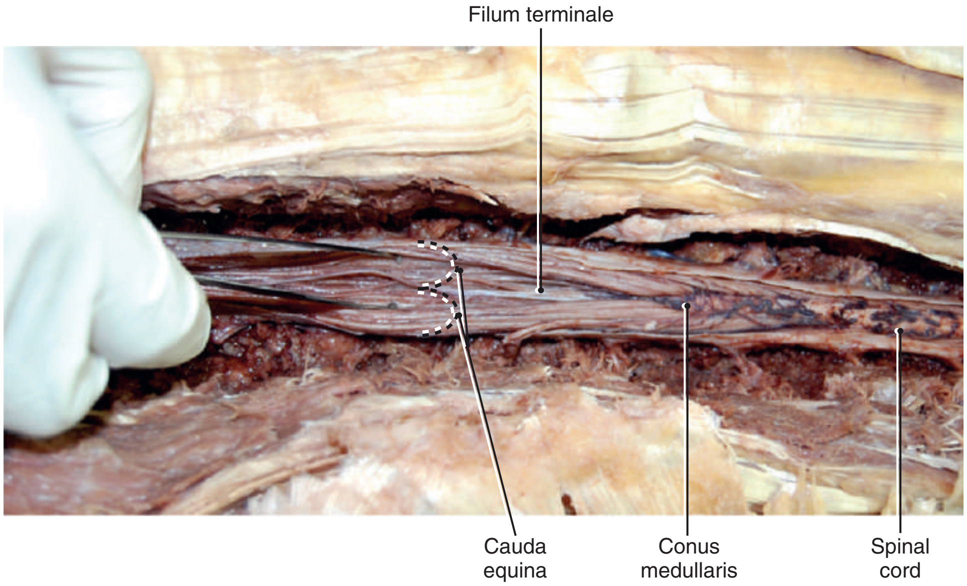
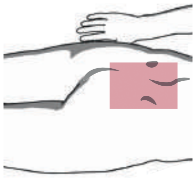


Fig. 3.34 Dura mater reflected to reveal spinal cord, conus medullaris, and filum terminale among cauda equina.



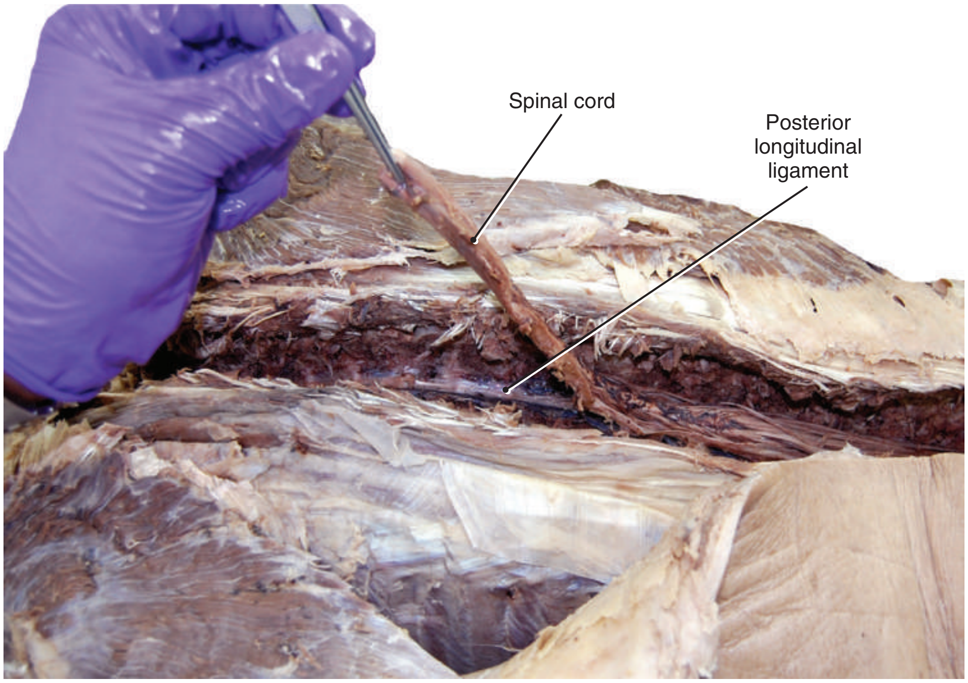
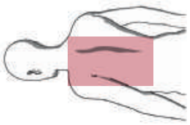


Fig. 3.35 Reflecting spinal cord from cephalad to caudal reveals posterior longitudinal ligament.



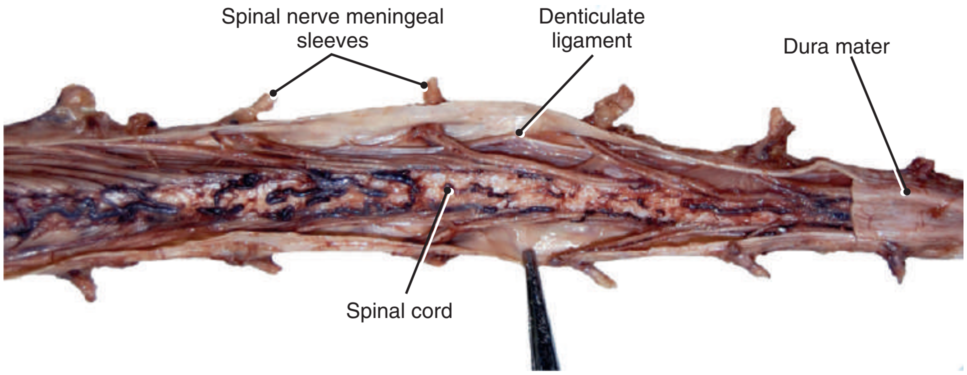

Spinal nerve meningeal sleeves
Denticulate ligament
Dura mater
Spinal cord

Fig. 3.36 Transverse and vertical incisions reflecting dura mater, revealing spinal cord, denticulate ligament, and spinal nerve dural sleeves.

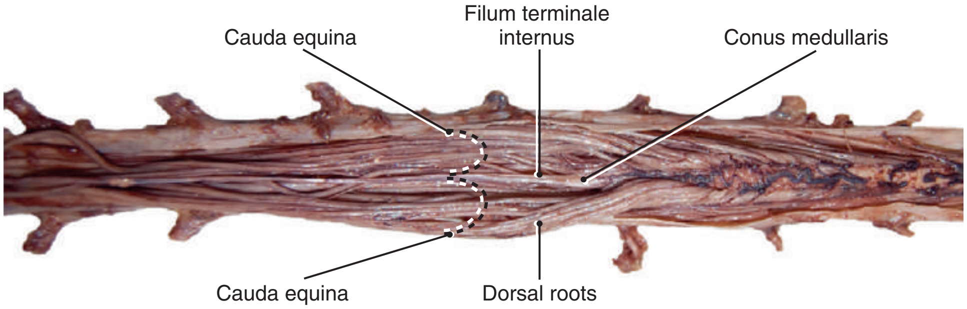

Cauda equina
Filum terminale internus
Conus medullaris
Cauda equina
Dorsal roots

Fig. 3.37 Transverse and vertical incisions reflecting dura mater, revealing conus medullaris, dorsal roots, and filum terminale.

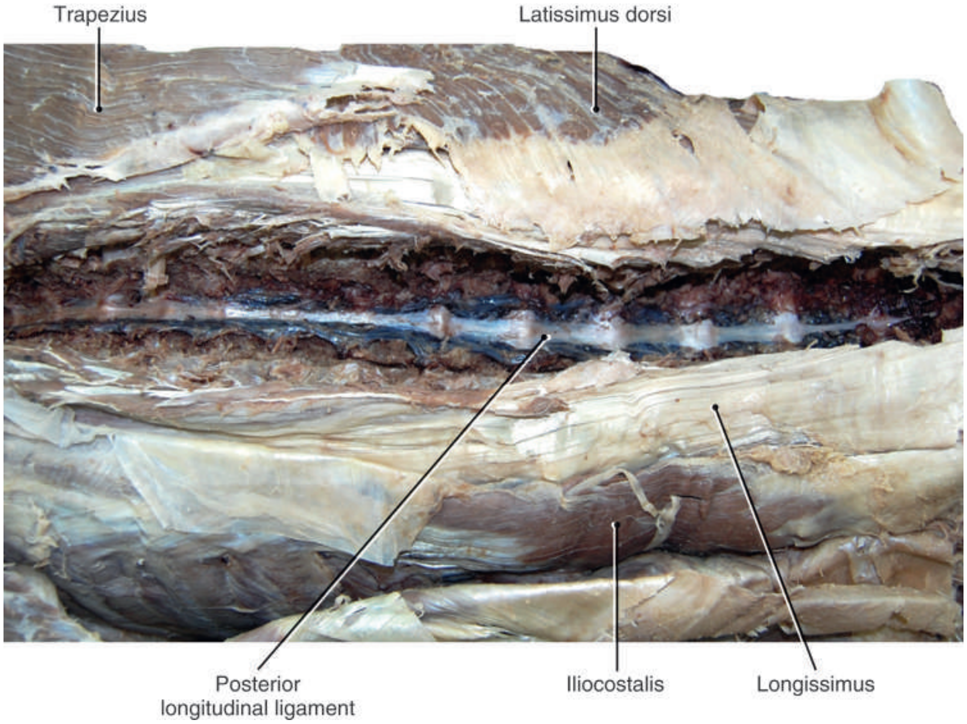
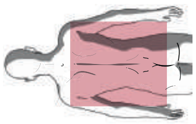

Trapezius
Latissimus dorsi
Posterior longitudinal ligament
Iliocostalis
Longissimus

Fig. 3.38 Spinal cord removed, revealing posterior longitudinal ligament.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

☐ Greater occipital nerve (dorsal ramus C2)
☐ Lesser occipital nerve (ventral rami of C2 and C3)
☐ 3rd occipital nerve (dorsal ramus C3)
☐ Suboccipital nerve (dorsal ramus C1)
☐ Dorsal root ganglion
☐ Spinal nerve

ARTERIES

☐ Occipital artery
☐ Vertebral artery

VEIN

☐ Vertebral venous plexus (Batson)

MUSCLES

☐ Trapezius
☐ Splenius capitis
☐ Semispinalis capitis
☐ Sternocleidomastoid
☐ Rectus capitis posterior major
☐ Rectus capitis posterior minor
☐ Obliquus capitis superior
☐ Obliquus capitis inferior
☐ Semispinalis capitis
☐ Erector spinae
☐ Spinalis
☐ Longissimus
☐ Iliocostalis
☐ Multifidus

BONES

☐ Atlas
    ☐ Posterior arch
☐ Spinous processes
☐ Lamina
☐ Transverse processes
☐ Body
☐ Vertebral foramen

LIGAMENTS

☐ Nuchal ligament (ligamentum nuchae)
☐ Ligamentum flavum
☐ Posterior longitudinal ligament

SPINAL CORD AND LAYERS

☐ Dura mater
☐ Arachnoid mater
☐ Pia mater
☐ Denticulate ligaments
☐ Filum terminale
☐ Conus medullaris
☐ Cauda equina
☐ Spinal nerve meningeal sleeve

CLINICAL APPLICATIONS

LUMBAR PUNCTURE

Gray's Anatomy for Students: 44, 45, 48
Netter: 166–169*

Clinical Application

A lumbar puncture uses a spinal needle to access the subarachnoid space between the 2nd and 4th lumbar vertebrae (L2 and L4) to withdraw cerebrospinal fluid for analysis (Fig. II.1).

Anatomic Landmarks

- **Below the L2 vertebra. Feel spinous processes and space between processes (Fig. II.2).**
- **Supracristal plane crosses L4/L5 junction. Puncture is safe just superior or inferior to this point, which avoids the spinal cord.**
- **Superficial to deep:**
  Skin
  Subcutaneous tissue
  Supraspinous ligament
  Interspinous ligament
  Ligamentum flavum (provides increased resistance to needle)
  Dura mater
  Subarachnoid space–cerebrospinal fluid

EXTRADURAL ANESTHESIA (CAUDAL OR SACRAL BLOCK)

Gray's Anatomy for Students: 44, 45, 48
Netter: 166, 169

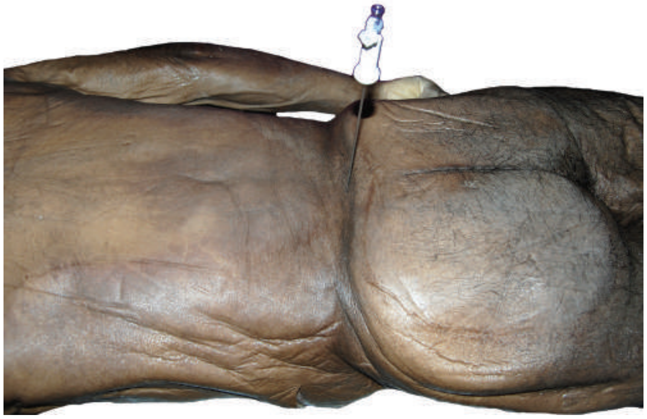


Fig. II.1

Clinical Application

Introduce anesthetic solutions into the epidural space, which will anesthetize the spinal nerves exiting the dura mater.

Anatomic Landmarks (Figs. II.4 and II.5)

- **Natal cleft**
- **Sacral cornu**
- **Superficial to deep:**
  Skin
  Subcutaneous tissue
  Posterior sacrococcygeal ligament (increased resistance)
  Sacral canal
- **Sacralization is the anomalous fusion of the 5th lumbar vertebra (L5) to the 1st sacral vertebra (S1) (Fig. II.3).**

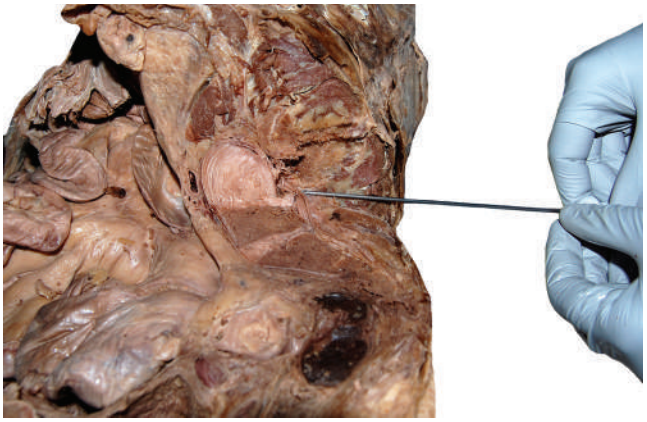


Fig. II.2

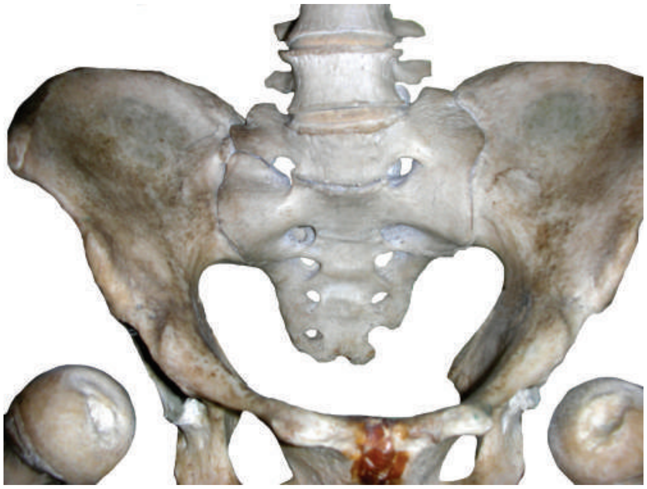


Fig. II.3

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*The Clinical Applications in each section are cross-referenced to the following sources: Drake: *Gray's Anatomy for Students*, ed 2, and Netter: *Atlas of Human Anatomy*, ed 7. Page references from each source are provided for procedures in the Clinical Applications.

TRIANGLE OF AUSCULTATION

Gray's Anatomy for Students: 37
Netter: 183

Clinical Application

The triangle of auscultation defines an area that allows better auscultation with a stethoscope (because of less overlying muscle mass), to maximize listening to the lungs, 6th intercostal space, and the gastroesophageal junction on the left and assessing potential pathology.

Anatomic Landmarks

- **Medial border of scapula**
- **Lateral border of trapezius**
- **Superior border of latissimus dorsi**

Note: Area of triangle increases when arms are crossed and trunk is flexed.

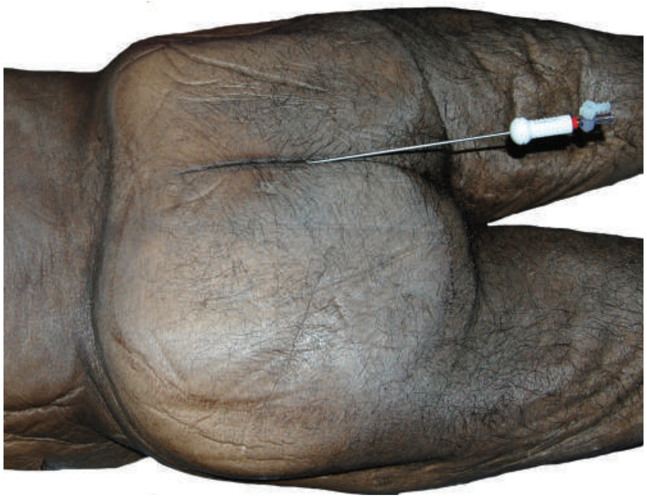


Fig. II.4

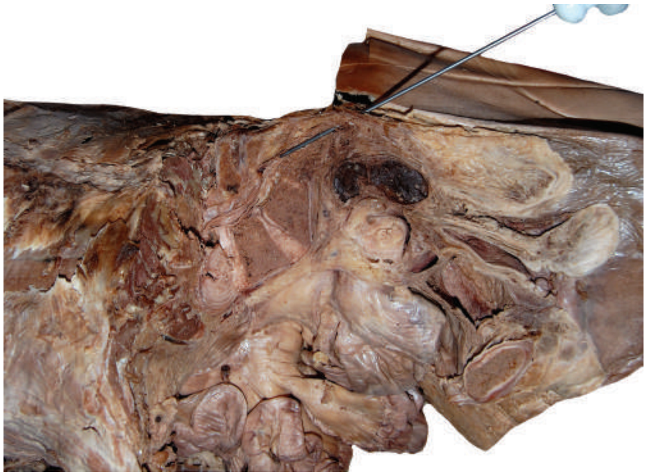


Fig. II.5

CHAPTER 4 PECTORAL REGION AND FEMALE BREAST

ATLAS REFERENCES

Netter: 187–191, 194, 195, 258–260, 416, 418
McMinn: 126–129, 178–181
Gray's Atlas: 62–72, 394–396, 402

SKIN AND SUPERFICIAL FASCIA

- Make an incision from the jugular notch over the clavicle to the shoulder (Fig. 4.1a).
- Make a midline incision from the jugular notch to the xiphoid process (Fig. 4.1b).
- Extend the incision across the border of the costal margin toward the midaxillary line (Fig. 4.1c).
- Continue the incision from the shoulder distally to the upper one third of the arm. An encircling incision around the midportion of the arm permits removal of the skin from the upper arm (Fig. 4.1d).
- Start the dissection at the junction of the jugular notch and the clavicle. Reflect the skin of anterior thoracic wall, medial to lateral using combined blunt and sharp dissection (Fig. 4.2).

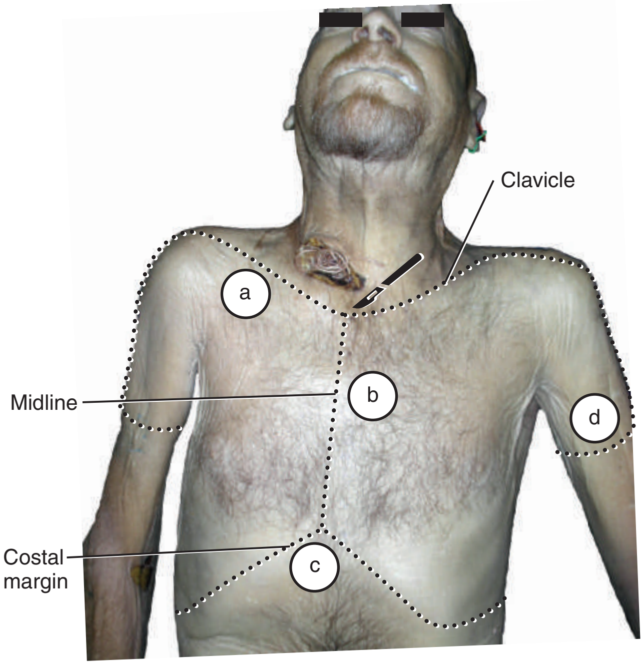


Fig. 4.1 Skin tracing of anterior thoracic wall for superficial dissection incisions. *a,* clavicle; *b,* midline; *c,* xiphoid process; *d,* upper arm.

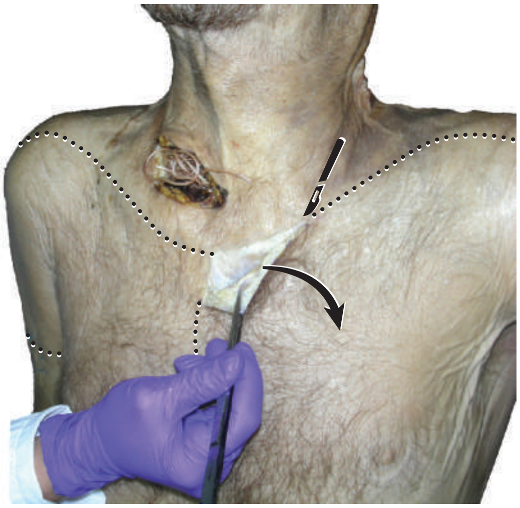
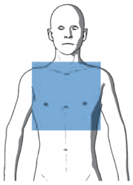


Fig. 4.2 Skin reflection of anterior thoracic wall, exposing deltopectoral region.



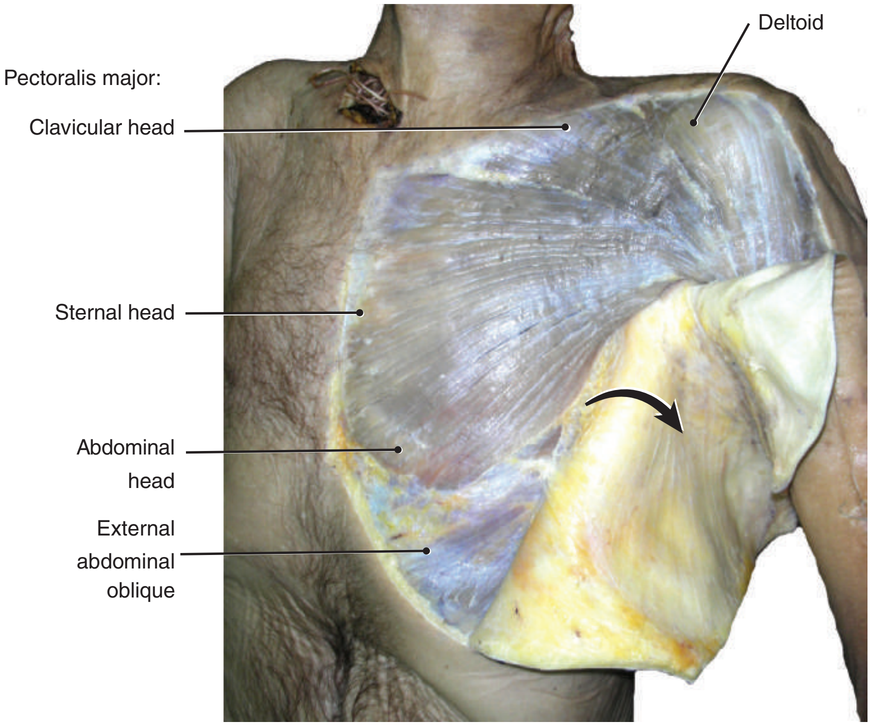
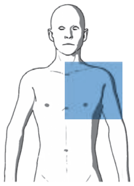

Deltoid
Pectoralis major:
Clavicular head
Sternal head
Abdominal head
External abdominal oblique

Fig. 4.3 Skin reflection of anterior thoracic wall, exposing the deltopectoral triangle, serratus anterior, and external abdominal oblique muscles.



DISSECTION **TIP**

As the superficial fascia and skin are retracted, you will encounter anterior cutaneous branches of ventral primary rami and vessels emerging near the sternum. The vessels are the perforating branches of the internal thoracic artery and the perforating tributaries to the internal thoracic vein. Cut through these cutaneous nerves and vessels.

- Reflect the skin and remove the superficial fascia from the thorax, shoulders, axillae, and proximal portions of the arms medially to the axilla (Figs. 4.3 and 4.4). Continue to use combined blunt and sharp dissection.

FEMALES

- In addition to the aforementioned incisions described in the reflection of the skin, make an oblique incision through the skin of the breast from the midpoint of the clavicle toward the anterior axillary line, encircling the areola (Fig. 4.5).
- Lift the skin at the edge of the incision with your forceps and reflect medially to the axilla.
- Start reflecting the adipose tissue from the pectoralis major with a scalpel (Figs. 4.6 and 4.7).

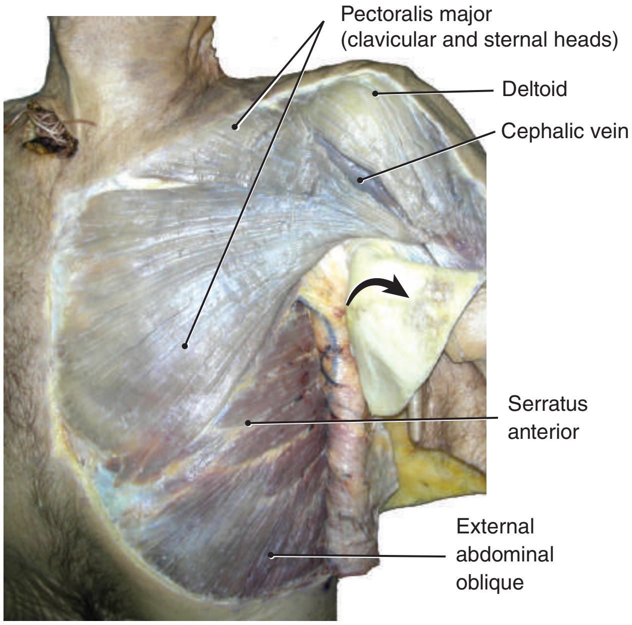
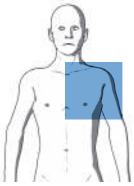

Pectoralis major (clavicular and sternal heads)
Deltoid
Cephalic vein
Serratus anterior
External abdominal oblique

Fig. 4.4 Skin reflection of anterior thoracic wall, medial to lateral.



ANATOMY **NOTE**

Note the retinacula cutis, which begins at the dermis and extends deeply into the breast, forming fibrous septae and irregular bands of dense connective tissue.

- **Cut through the middle of the areola, making a sagittal incision through the nipple-areolar complex, revealing glandular tissue, ducts, connective tissue, and fat of the breast (Fig. 4.8). Partially remove the breast (Fig. 4.9). Try to identify one or more lactiferous ducts (Fig. 4.10).**

ANATOMY **NOTE**

The lactiferous ducts may possess an expanded part (the lactiferous sinus or ampulla) deep to the nipple. The ducts become very narrow as they pass through the nipple, each terminating separately upon its surface. In most aged cadavers, little will remain of the duct system or glandular tissue, being replaced with fibrous tissue infiltrated with fat.

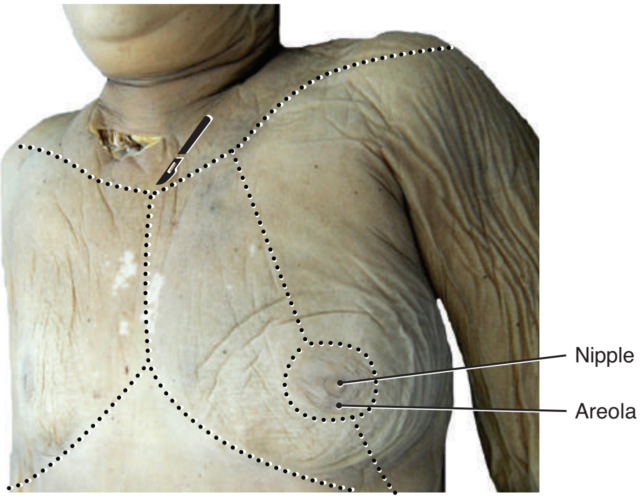


Fig. 4.5 Skin of female breast with nipple-areolar complex.

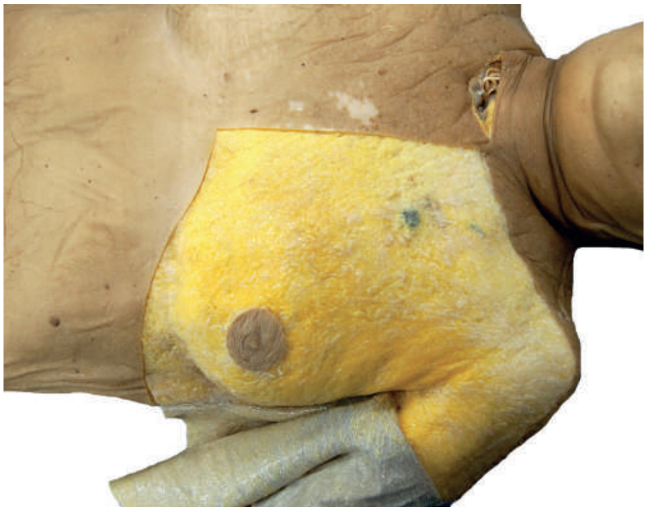
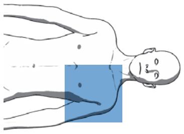


Fig. 4.6 Skin reflection from anterior thoracic wall (same technique as Fig. 4.2), revealing superficial fascia and nipple-areolar complex.



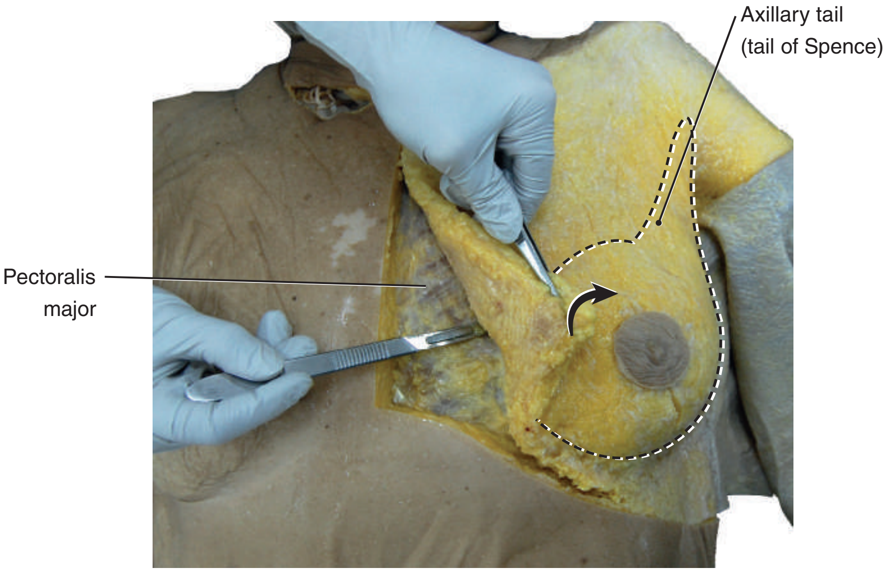
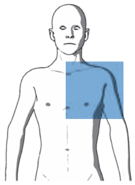


Fig. 4.7 Reflecting left breast, deep to superficial fascia.



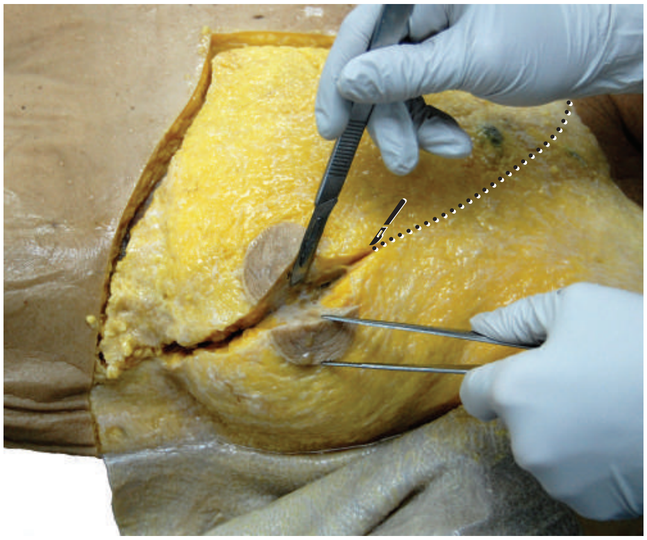
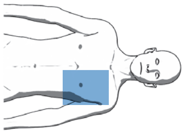


Fig. 4.8 Sagittal incision through the nipple-areolar complex, revealing glandular tissue, ducts, connective tissue, and fat of breast.



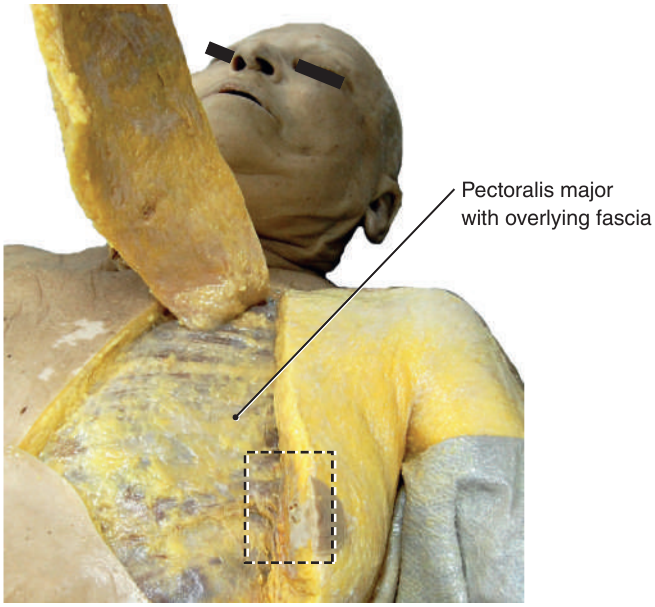

Pectoralis major
with overlying fascia

Fig. 4.9 Partial removal of left breast, revealing pectoralis major and fascia lying deep to breast.

DISSECTION **TIP**

Sometimes it is possible to identify an injection reservoir under the subcutaneous tissue (Fig. 4.11). These allow direct access to a large vein without having to "stick" the vein each time and are used for long-term injections such as for chemotherapy.

SUPERFICIAL DISSECTION

- Identify the pectoralis major muscle, which is invested in a thin tough fascia, the pectoral fascia (part of the deep fascia system) (Fig. 4.12).

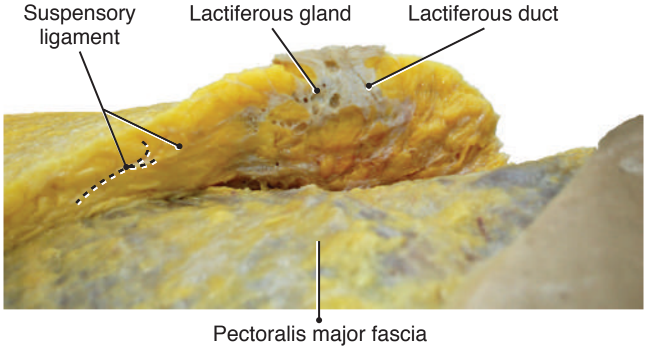

Suspensory
ligament
Lactiferous gland
Lactiferous duct
Pectoralis major fascia

Fig. 4.10 Sagittal incision through the nipple-areolar complex, revealing gland, duct, and suspensory ligament of breast (see dashed square in Fig. 4.9).

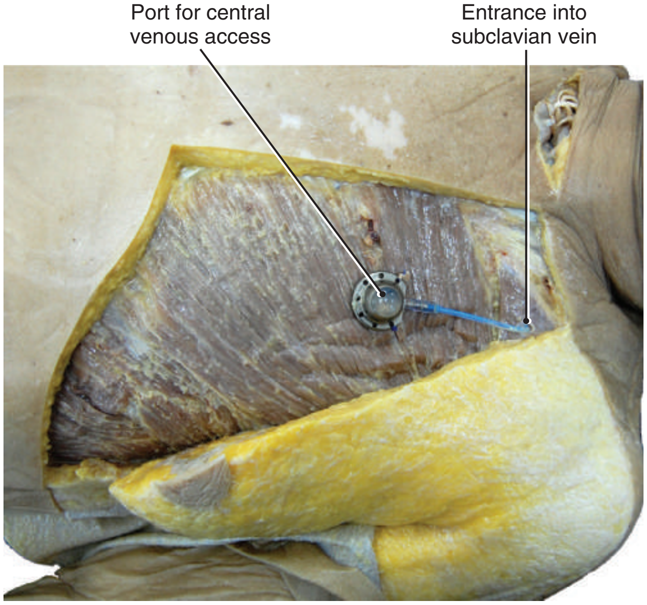
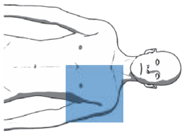

Port for central
venous access
Entrance into
subclavian vein

Fig. 4.11 Left pectoralis major with overlying central venous port.



- After cleaning the fascia from the pectoralis major, notice the separation of the pectoralis major from the deltoid muscle by the deltopectoral triangle (see Fig. 4.12).

ANATOMY **NOTE**

The clavicle, the clavicular head of the pectoralis major muscle, and the deltoid muscle form this triangle. Within the deltopectoral triangle, the cephalic vein is found.

- Dividing the fascia that lies superficial to it will expose the cephalic vein. The cephalic vein is an important landmark for identifying the first part of the axillary artery (see Fig. 4.12).

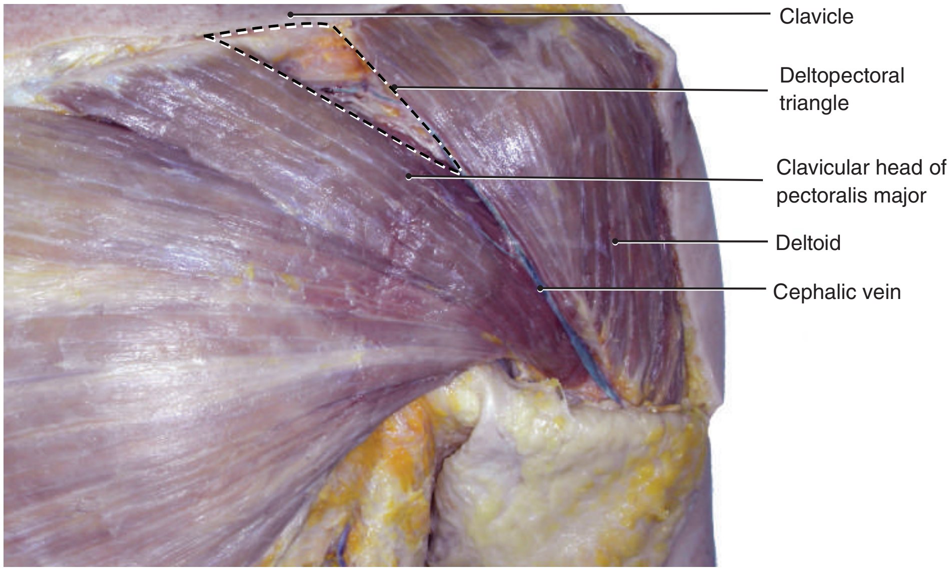
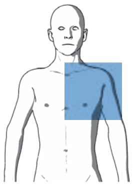

Clavicle
Deltopectoral triangle
Clavicular head of pectoralis major
Deltoid
Cephalic vein

Fig. 4.12 Skin reflected from left anterolateral thoracic wall, revealing deltopectoral muscles, deltopectoral triangle, and cephalic vein.



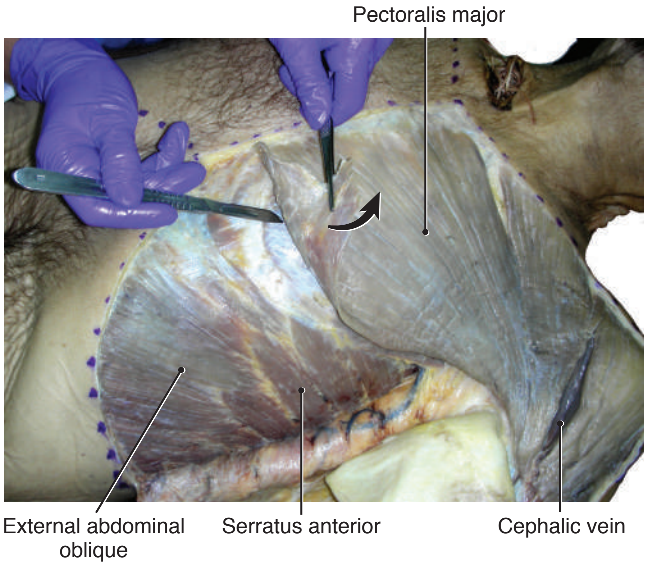
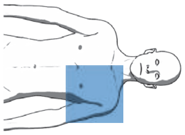

Pectoralis major
External abdominal oblique
Serratus anterior
Cephalic vein

Fig. 4.13 Left pectoralis major muscle reflected from anterior chest wall.



- **Detach the clavicular, sternal, and abdominal parts of the pectoralis major with a scalpel and reflect the muscle laterally to its insertion onto the humerus (Fig. 4.13).**

- **Transect the clavicular portion of the pectoralis major muscle to the midclavicular line to avoid cutting important vessels and nerves, including the medial and lateral pectoral nerves (Fig. 4.14).**

DISSECTION **TIP**

When the pectoralis major is reflected, pay special attention so as not to transect the medial pectoral nerve as it passes through (or lies lateral or inferior to) the pectoralis minor muscle to enter the pectoralis major.

DEEP DISSECTION

- **After the pectoralis major has been reflected, identify the upper border of pectoralis minor and dissect the clavipectoral fascia to expose the subclavian and axillary vein (Fig. 4.15).**

ANATOMY **NOTE**

The clavipectoral fascia attaches proximally to the clavicle and invests the subclavius muscle. It then passes as a sheet toward the pectoralis minor, invests it, and then blends distally with axillary fascia forming the so-called suspensory ligament of the axilla.

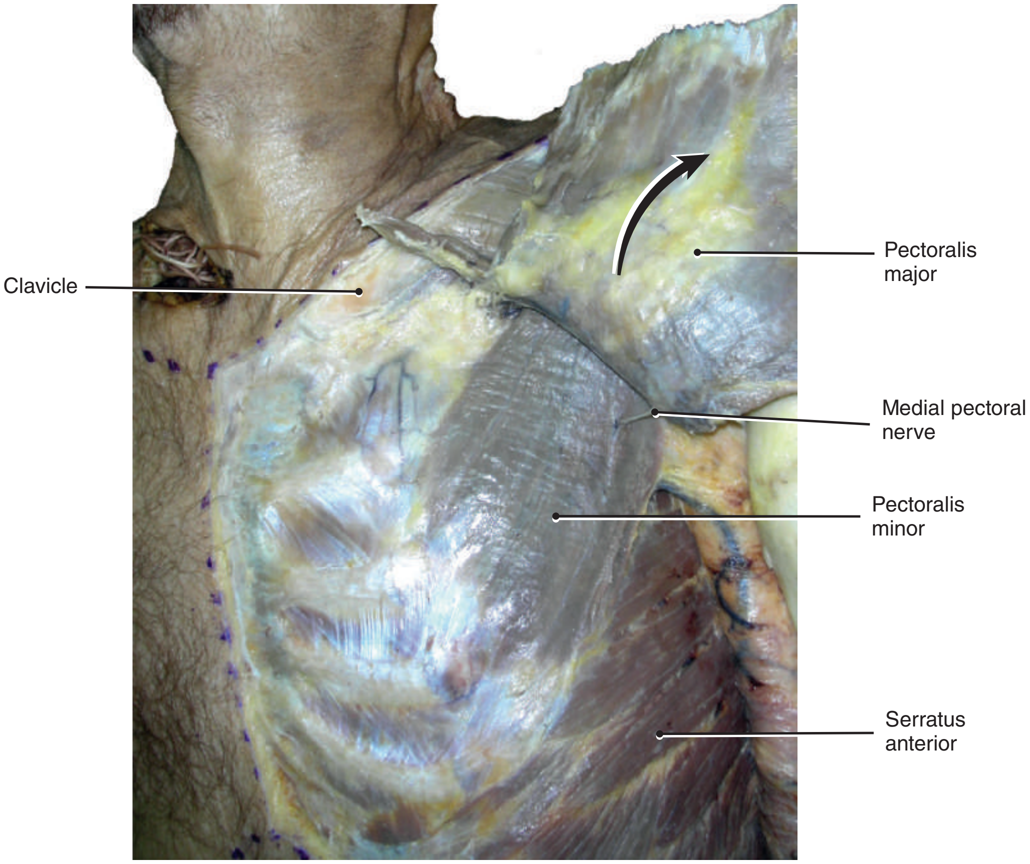
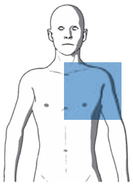

Clavicle
Pectoralis major
Medial pectoral nerve
Pectoralis minor
Serratus anterior

Fig. 4.14 Reflection of pectoralis major muscle highlighting pectoralis minor attachment to ribs 3 through 5.



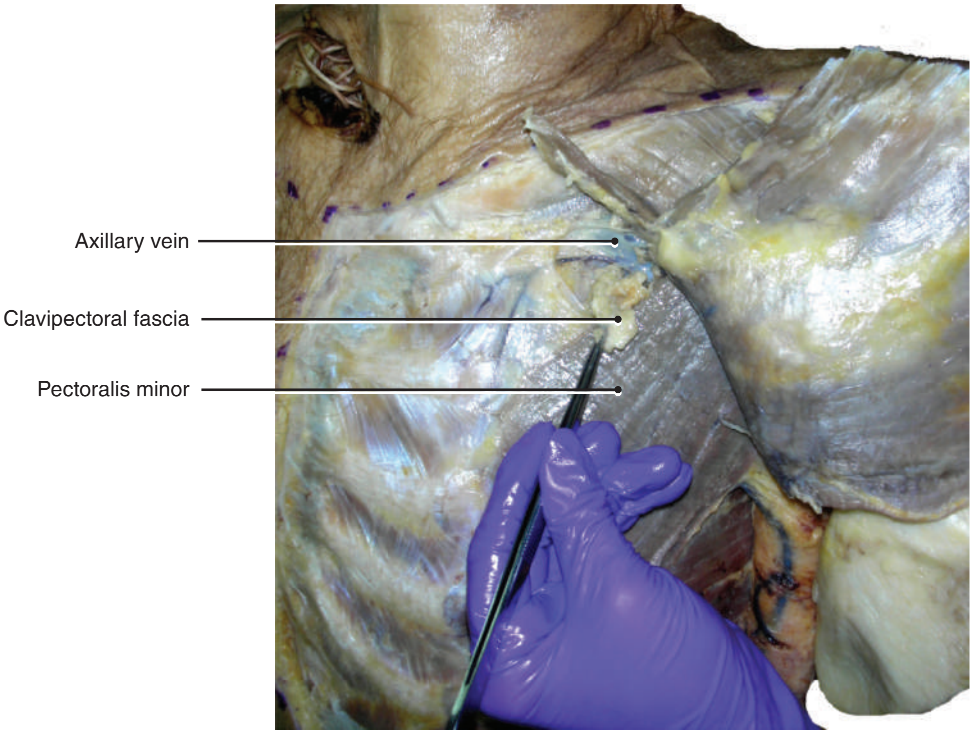
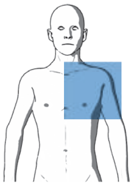

Axillary vein
Clavipectoral fascia
Pectoralis minor

Fig. 4.15 Reflection of pectoralis major muscle and its fascia, revealing the clavipectoral fascia.



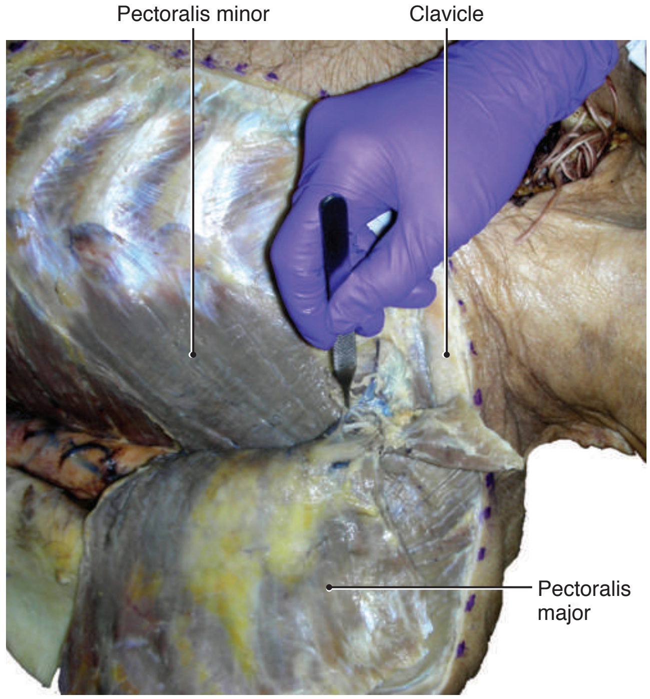
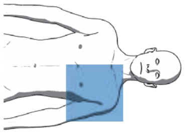

Pectoralis minor
Clavicle
Pectoralis major

Fig. 4.16 Removal of clavipectoral fascia and identification of axillary vein.



- Next observe the subclavian vein, the lateral pectoral nerves, and the pectoral branches of the thoracoacromial artery as they emerge to reach the pectoralis major muscle (Figs. 4.16 and 4.17).
- Trace the pectoral arteries to their origin from the thoracoacromial artery, and preserve these as the dissection proceeds.
- Insert the scissors under the inferior border of the pectoralis minor and cut the connective tissue underneath (Fig. 4.18). Reflect the pectoralis minor anteriorly.
- With a scalpel, reflect the pectoralis minor from ribs 3 through 5 (Fig. 4.19).

DISSECTION TIP

Often, in older cadavers, large lymph nodes located deep to the pectoralis minor (retropectoral nodes) may be evident.

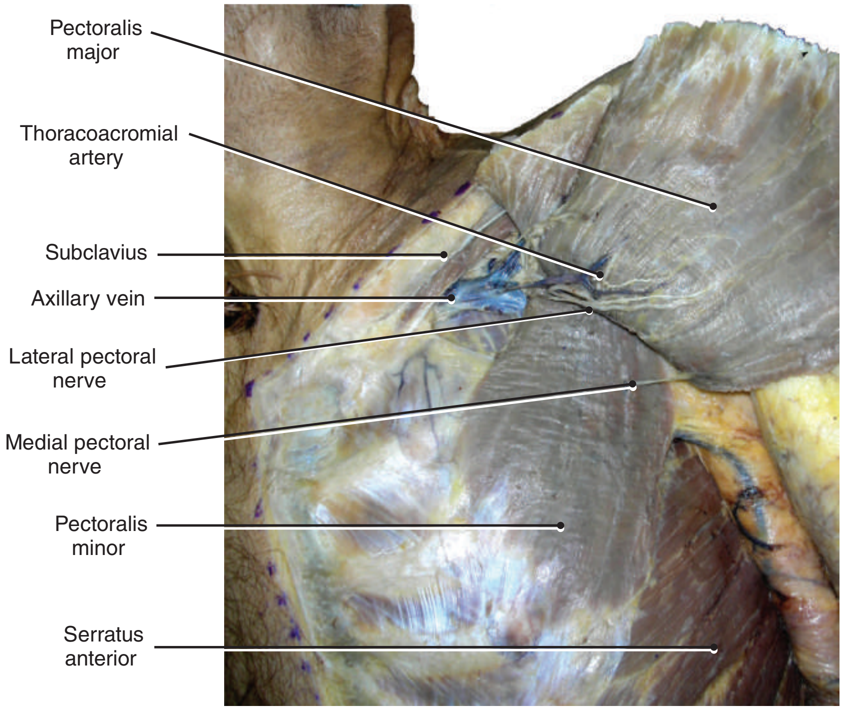
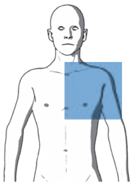

Pectoralis major
Thoracoacromial artery
Subclavius
Axillary vein
Lateral pectoral nerve
Medial pectoral nerve
Pectoralis minor
Serratus anterior

Fig. 4.17 Reflection of pectoralis major and its fascia, revealing medial and lateral pectoral nerves.



- As the superficial fascia is reflected from the anterolateral aspect of the thoracic wall, look for the thoracoepigastric vein. The thoracoepigastric vein is a tributary to the axillary vein by direct or indirect connections. During the reflection of the fascia near the midaxillary line, lateral cutaneous branches of ventral primary rami may be exposed where they enter the superficial fascia (Fig. 4.20). Try to preserve as many of these as possible.

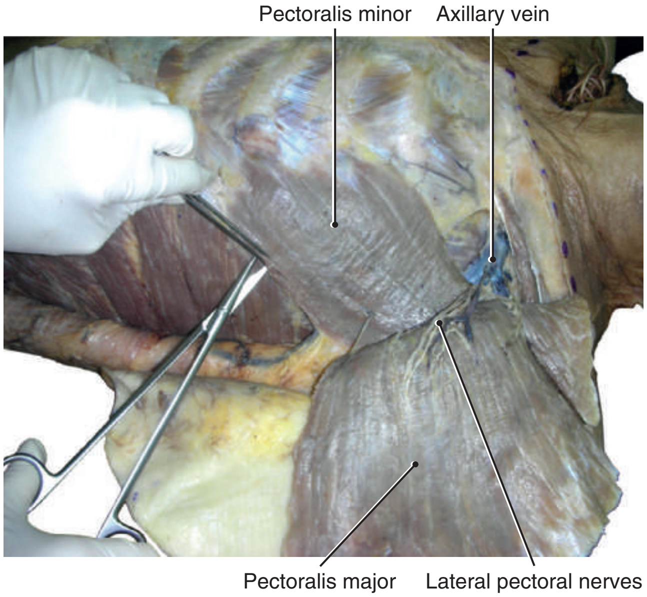
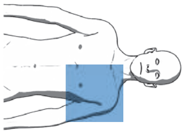

Pectoralis minor
Axillary vein
Pectoralis major
Lateral pectoral nerves

Fig. 4.18 Reflection of pectoralis major and its fascia, revealing pectoralis minor muscle. Scissors are positioned along the lateral inferior border of pectoralis minor.



- Identify the long thoracic nerve, which innervates the serratus anterior muscle (see Fig. 4.20). Trace the nerve a few centimeters inferior to the junction of the T2 ventral primary ramus (intercostobrachial nerve) and the thoracoepigastric vein at the midaxillary line over the serratus anterior muscle.

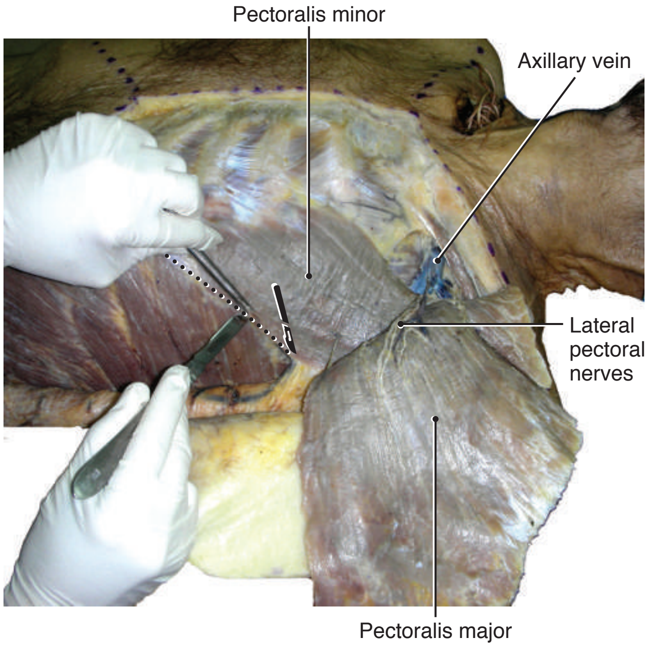
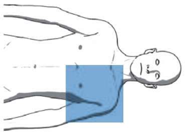

Pectoralis minor
Axillary vein
Lateral pectoral nerves
Pectoralis major

Fig. 4.19 Reflection of pectoralis major and its fascia, revealing pectoralis minor muscle. Place scalpel tip under lateral inferior border of pectoralis minor.



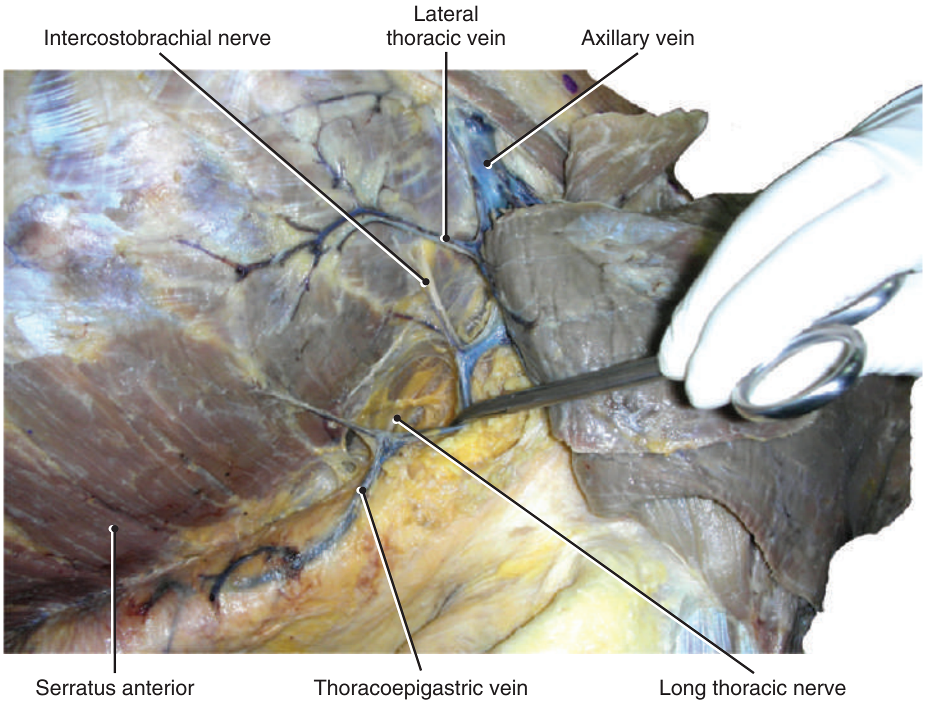
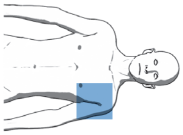

Intercostobrachial nerve
Lateral thoracic vein
Axillary vein
Serratus anterior
Thoracoepigastric vein
Long thoracic nerve

Fig. 4.20 Reflection of pectoralis major and minor muscles and deep fascia, revealing veins and, intercostobrachial and long thoracic nerves.



- Remove part of the axillary sheath and the axillary fascia deep to the pectoralis major. This tube-like fascia covers the axillary artery, axillary vein, and the brachial plexus and is derived from the prevertebral fascia. With your scissors separate the fascia and remove most of it (Figs. 4.21 and 4.22). Once the fascia is removed, replace the pectoralis minor over the axillary artery.

- Clean the intercostobrachial nerve (T2), which emerges from the 2nd intercostal space. This nerve supplies the skin of the axilla and the proximal medial aspect of the arm. In some specimens, the 3rd intercostal nerve may communicate with the intercostobrachial nerve. Clean this nerve toward the skin of the axilla (Fig. 4.23).

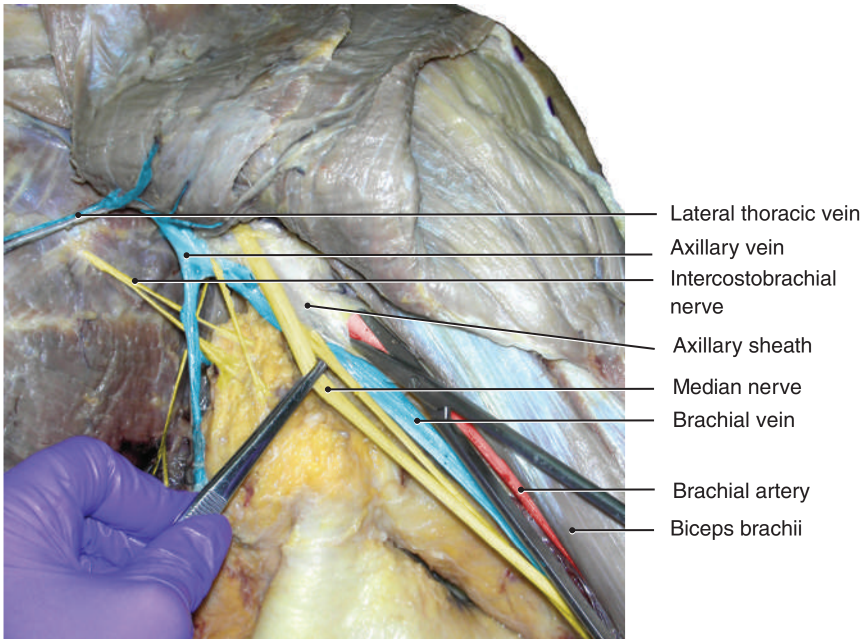
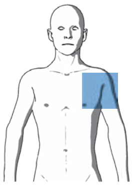

Lateral thoracic vein
Axillary vein
Intercostobrachial nerve
Axillary sheath
Median nerve
Brachial vein
Brachial artery
Biceps brachii

Fig. 4.21 Reflection of pectoralis major and minor muscles and deep fascia, revealing axillary sheath, axillary and brachial veins, and the median nerve.



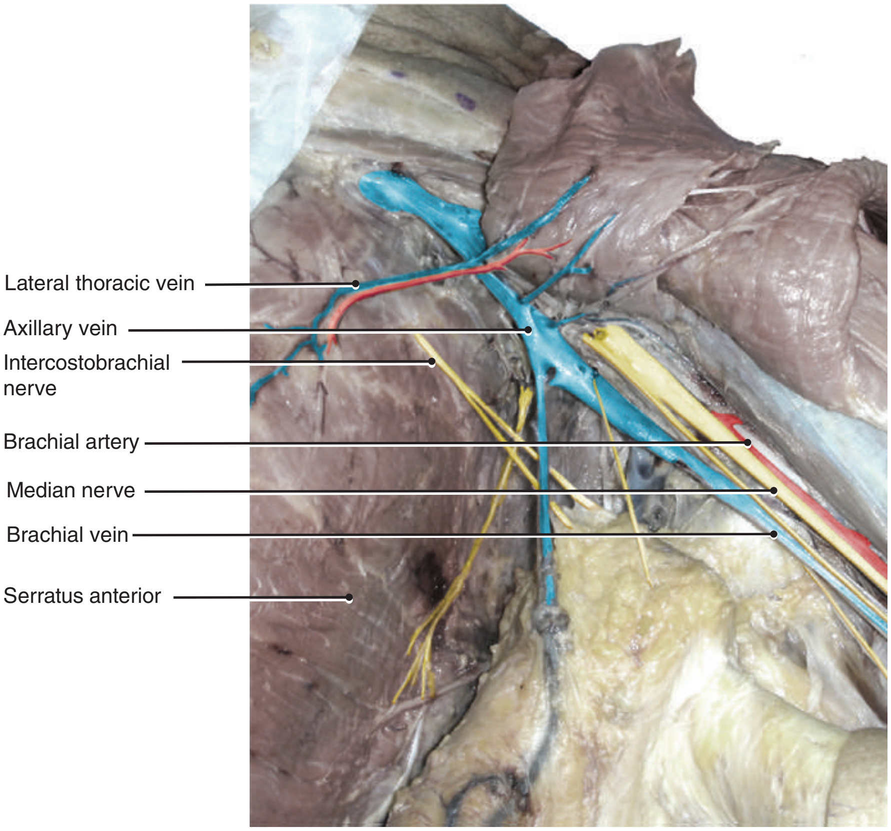
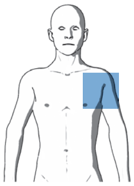

Lateral thoracic vein
Axillary vein
Intercostobrachial nerve
Brachial artery
Median nerve
Brachial vein
Serratus anterior

Fig. 4.22 Reflection of pectoralis major and minor muscles and deep fascia, revealing neurovascular structures of the axillary region.



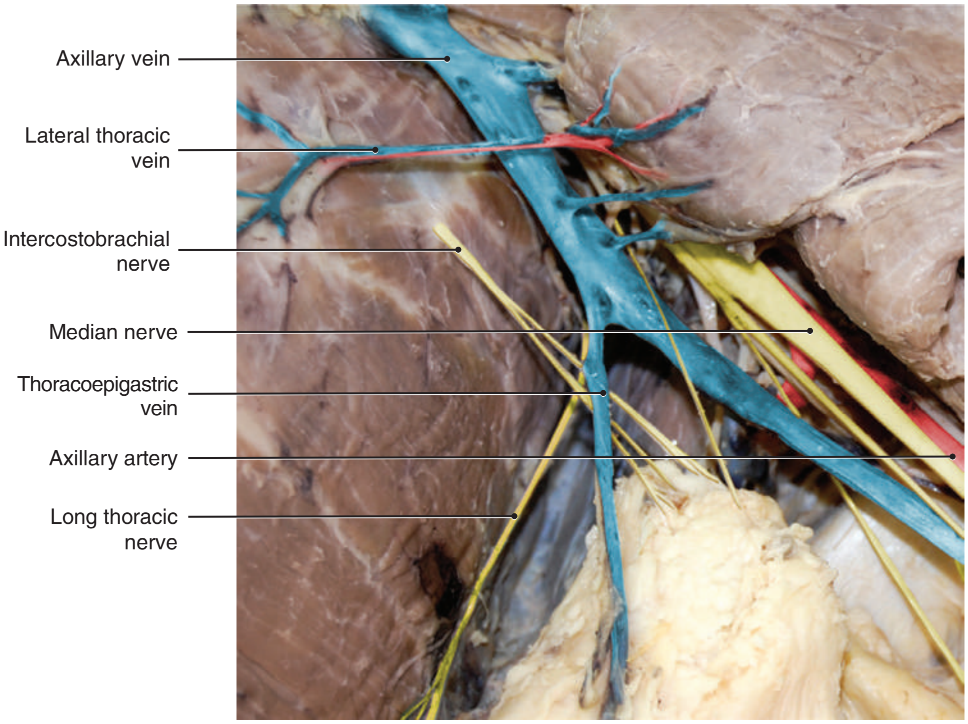
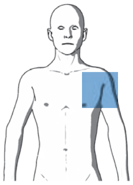
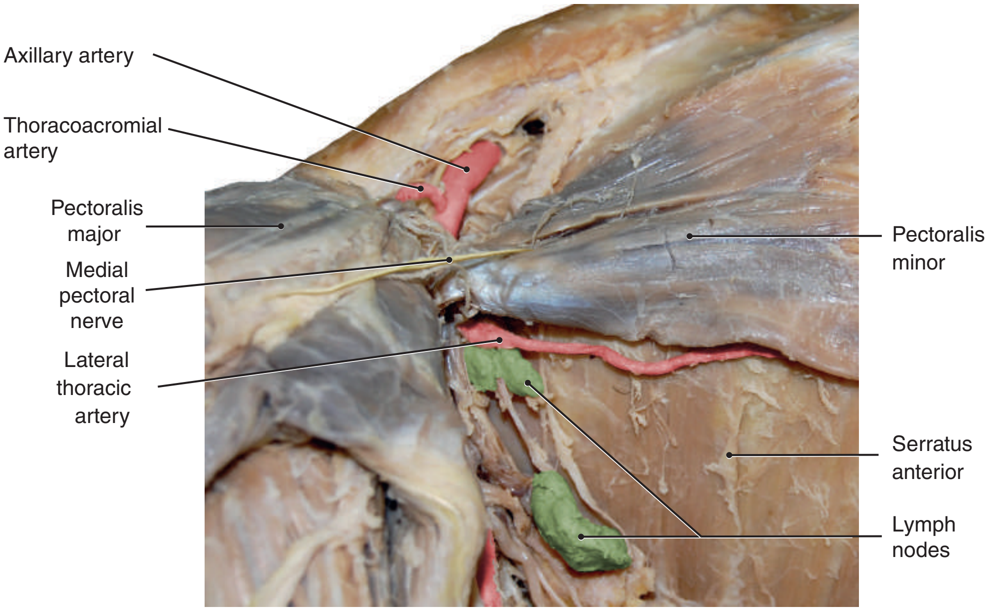

Axillary vein
Lateral thoracic vein
Intercostobrachial nerve
Median nerve
Thoracoepigastric vein
Axillary artery
Long thoracic nerve

Fig. 4.23 Reflection of pectoralis major muscle and fascia, revealing pectoralis minor and relationship to axillary and long thoracic arteries.

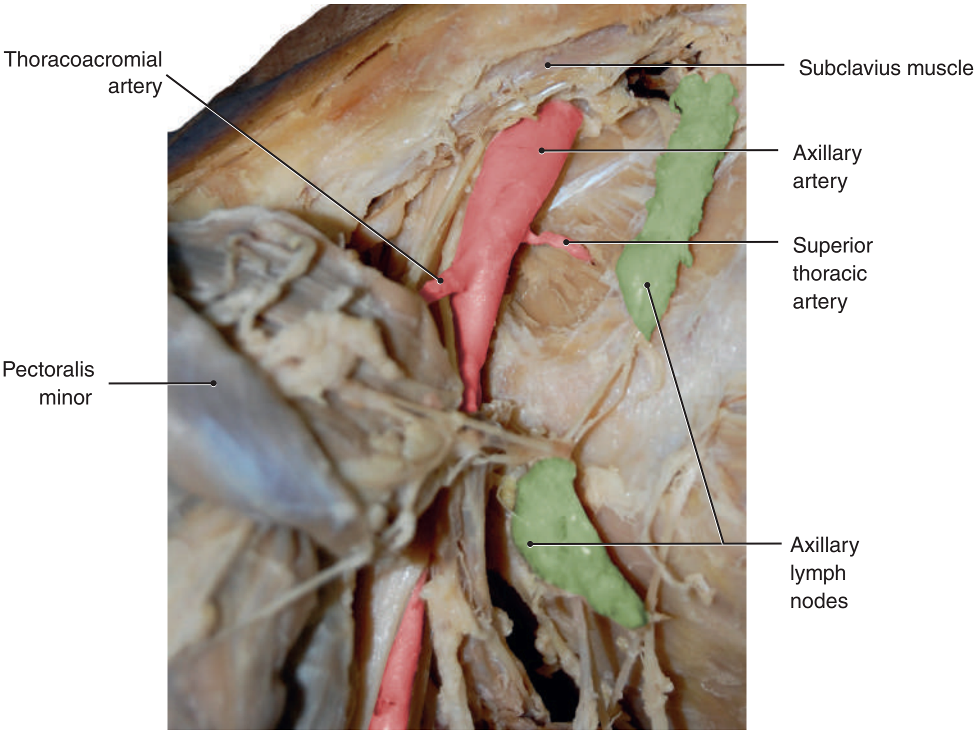


- The pectoralis minor muscle divides the axillary artery into three parts (Fig. 4.24).
- At the lateral border of the pectoralis minor on the surface of the serratus anterior, expose the lateral thoracic artery (see Fig. 4.24).
- Its origin is typically from the 2nd portion of the axillary artery; however, this may vary. Look carefully for a small artery penetrating the musculature of the 1st or 2nd intercostal spaces. This is the superior thoracic artery that arises from the 1st part of the axillary artery (Fig. 4.25, Plates 4.1 and 4.2).



Axillary artery
Thoracoacromial artery
Pectoralis major
Medial pectoral nerve
Lateral thoracic artery
Pectoralis minor
Serratus anterior
Lymph nodes

Fig. 4.24 Reflection of pectoralis major muscle exposing lateral thoracic artery, seen traveling along the lateral border of the pectoralis minor muscle.



Thoracoacromial artery
Subclavius muscle
Axillary artery
Superior thoracic artery
Pectoralis minor
Axillary lymph nodes

Fig. 4.25 Dissection of axillary region, revealing reflected pectoralis minor muscle, axillary and superior thoracic arteries, and axillary lymph nodes.

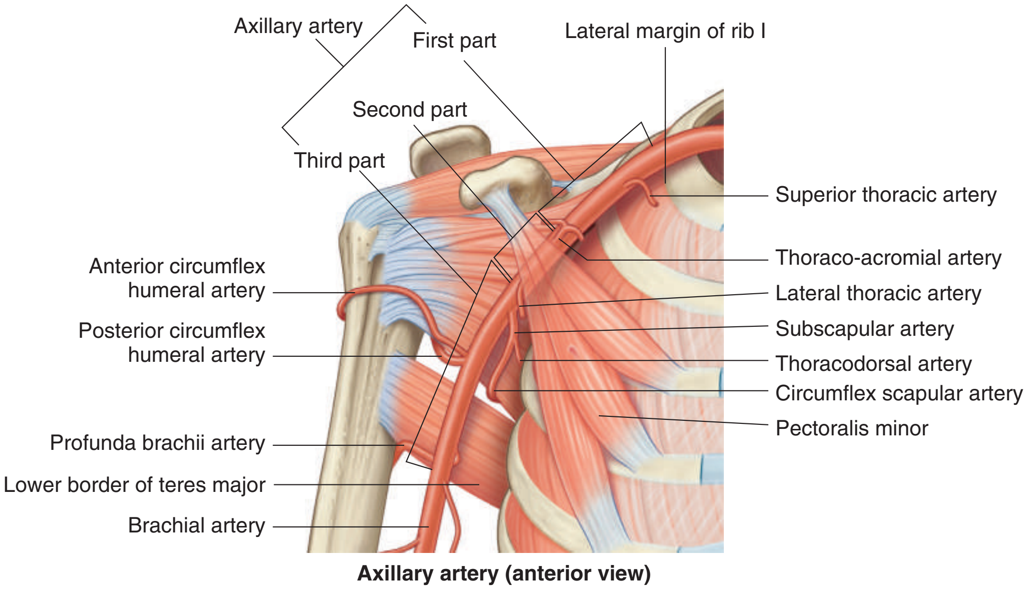

Axillary artery
First part
Lateral margin of rib I
Second part
Third part
Superior thoracic artery
Thoraco-acromial artery
Lateral thoracic artery
Subscapular artery
Thoracodorsal artery
Circumflex scapular artery
Pectoralis minor
Anterior circumflex humeral artery
Posterior circumflex humeral artery
Profunda brachii artery
Lower border of teres major
Brachial artery
Axillary artery (anterior view)

Plate 4.1 Divisions of axillary artery.

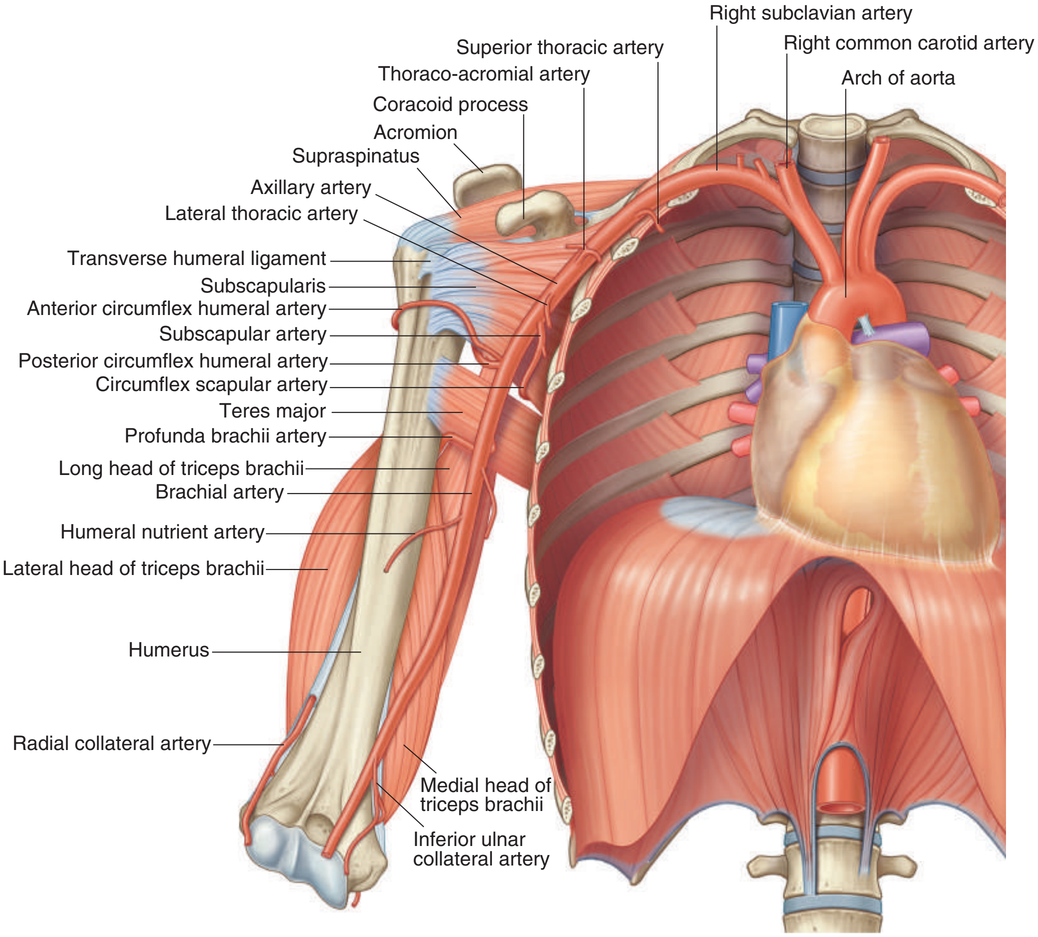

Right subclavian artery
Superior thoracic artery
Right common carotid artery
Thoraco-acromial artery
Arch of aorta
Coracoid process
Acromion
Supraspinatus
Axillary artery
Lateral thoracic artery
Transverse humeral ligament
Subscapularis
Anterior circumflex humeral artery
Subscapular artery
Posterior circumflex humeral artery
Circumflex scapular artery
Teres major
Profunda brachii artery
Long head of triceps brachii
Brachial artery
Humeral nutrient artery
Lateral head of triceps brachii
Humerus
Radial collateral artery
Medial head of triceps brachii
Inferior ulnar collateral artery

Plate 4.2 Branches of axillary artery.

○ **Place a probe or your scissors between the external intercostal membrane and the internal intercostal muscle (Fig. 4.26).**

ANATOMY **NOTE**

The external intercostal membrane travels between the lateral border of the sternum and the midclavicular line.

○ **Cut this membrane and expose the internal intercostal muscle (Figs. 4.26 and 4.27).**

ANATOMY **NOTE**

This muscle layer runs in a direction opposite to the external intercostals, like “hands in your back pockets.” The external intercostal muscles are oriented in a direction medially and downward, like “hands in your front pockets” (Fig. 4.28). Near the sternum, the external intercostal muscles are continued medially as the external intercostal membrane.

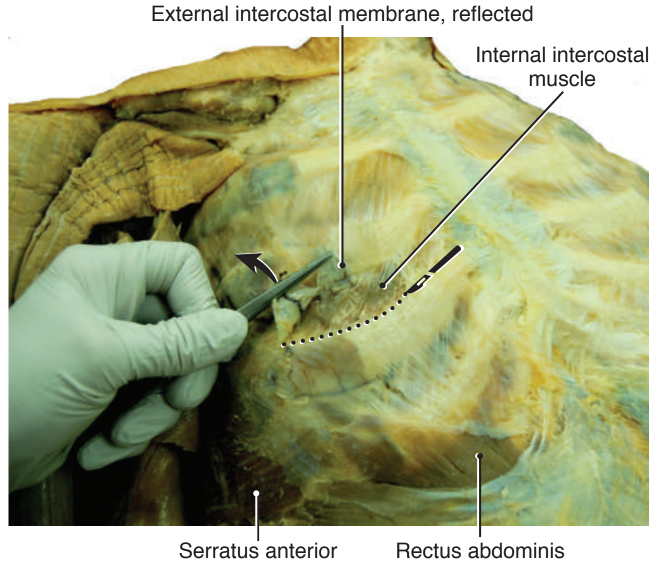
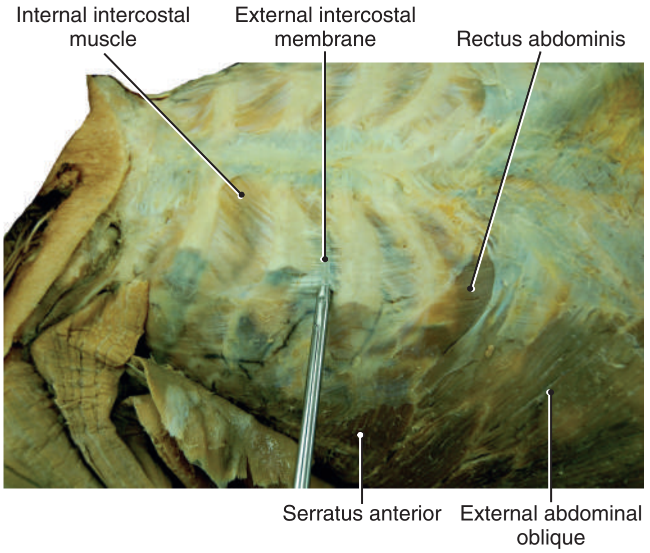

External intercostal membrane, reflected
Internal intercostal muscle
Serratus anterior
Rectus abdominis

Fig. 4.27 The external intercostal membrane is cut and reflected laterally to reveal internal intercostal muscle.


Internal intercostal muscle
External intercostal membrane
Rectus abdominis
Serratus anterior
External abdominal oblique

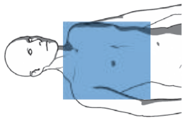
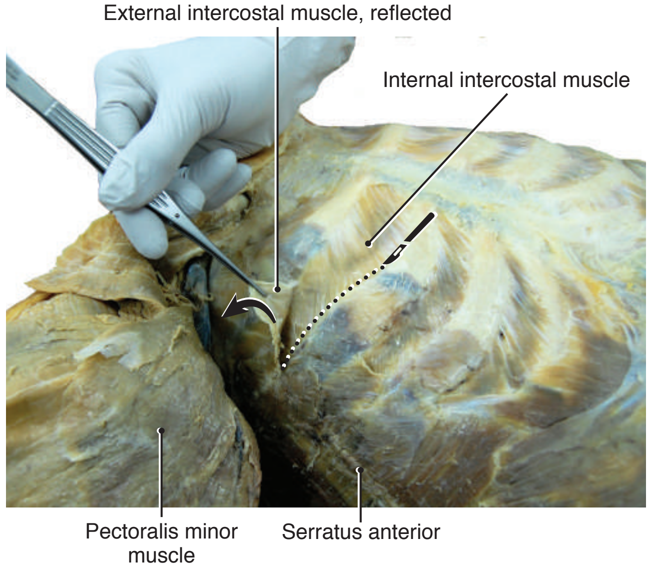


Fig. 4.26 Anterior thoracic wall musculature, revealing external intercostal membrane (over the scissors), internal intercostal, external abdominal oblique, rectus abdominis, and serratus anterior muscles.


External intercostal muscle, reflected
Internal intercostal muscle
Pectoralis minor muscle
Serratus anterior

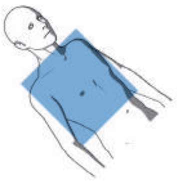
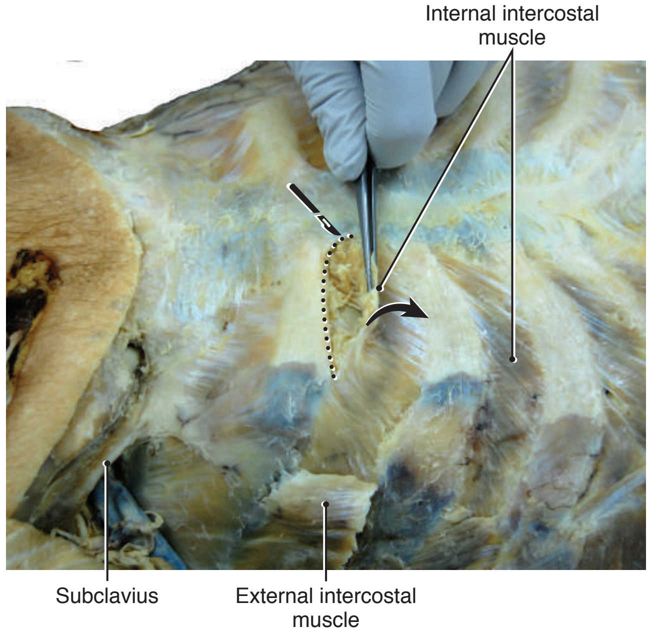


Fig. 4.28 Anterolateral chest wall with reflected pectoralis muscle and fascia, revealing external intercostal, internal intercostal, and serratus anterior muscles.

- **Reflect the internal intercostal muscle adjacent to the sternum and expose the contents of the intercostal space (Figs. 4.29 and 4.30).**
- **Identify the endothoracic fascia and carefully reflect it (Fig. 4.31).**
- **Identify the internal thoracic artery and vein (Figs. 4.32 and 4.33).**


Internal intercostal muscle
Subclavius
External intercostal muscle

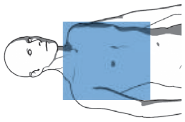
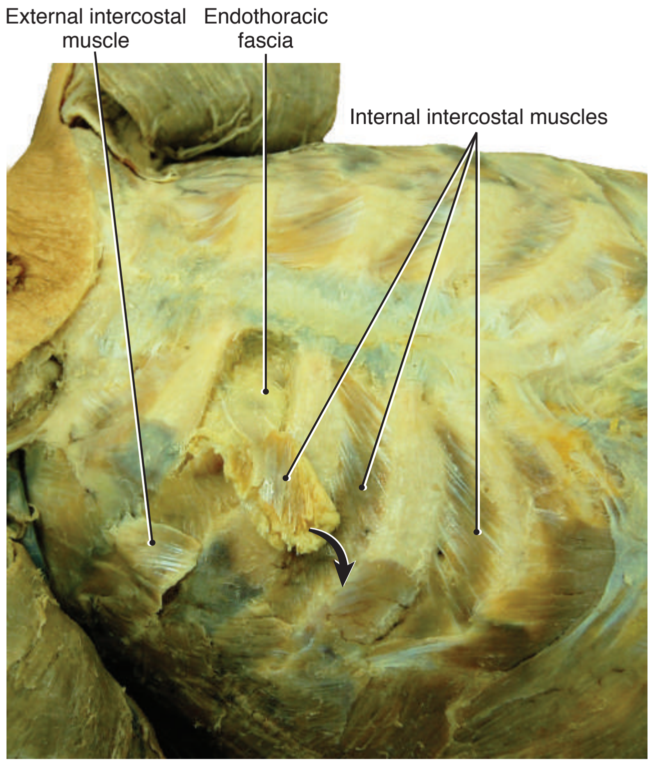


Fig. 4.29 Anterolateral chest wall revealing subclavius, external intercostal, and internal intercostal muscles. The internal intercostal muscle is cut superiorly and reflected inferiorly to expose the endothoracic fascia.


External intercostal muscle
Endothoracic fascia
Internal intercostal muscles

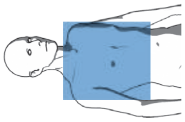
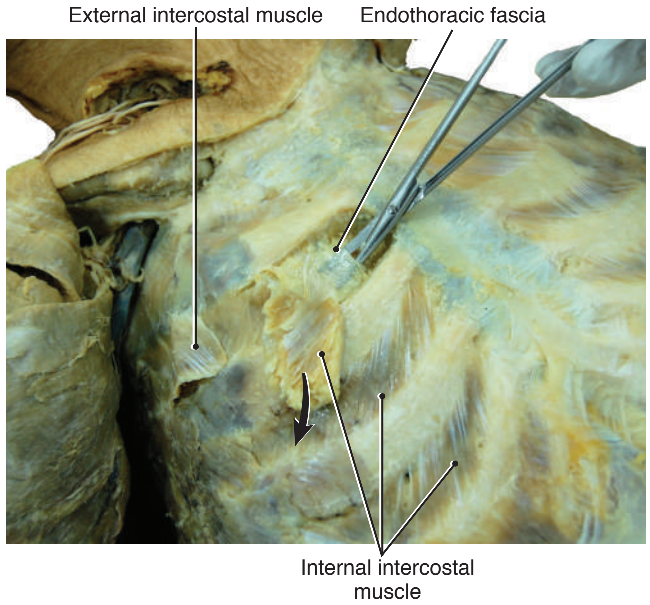


Fig. 4.30 Anterolateral chest wall with reflected internal intercostal, revealing endothoracic fascia and external and internal intercostal muscles.


External intercostal muscle
Endothoracic fascia
Internal intercostal muscle

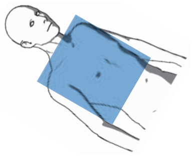


Fig. 4.31 Anterolateral chest wall with reflected internal intercostal, revealing endothoracic fascia with external and internal intercostal muscles.

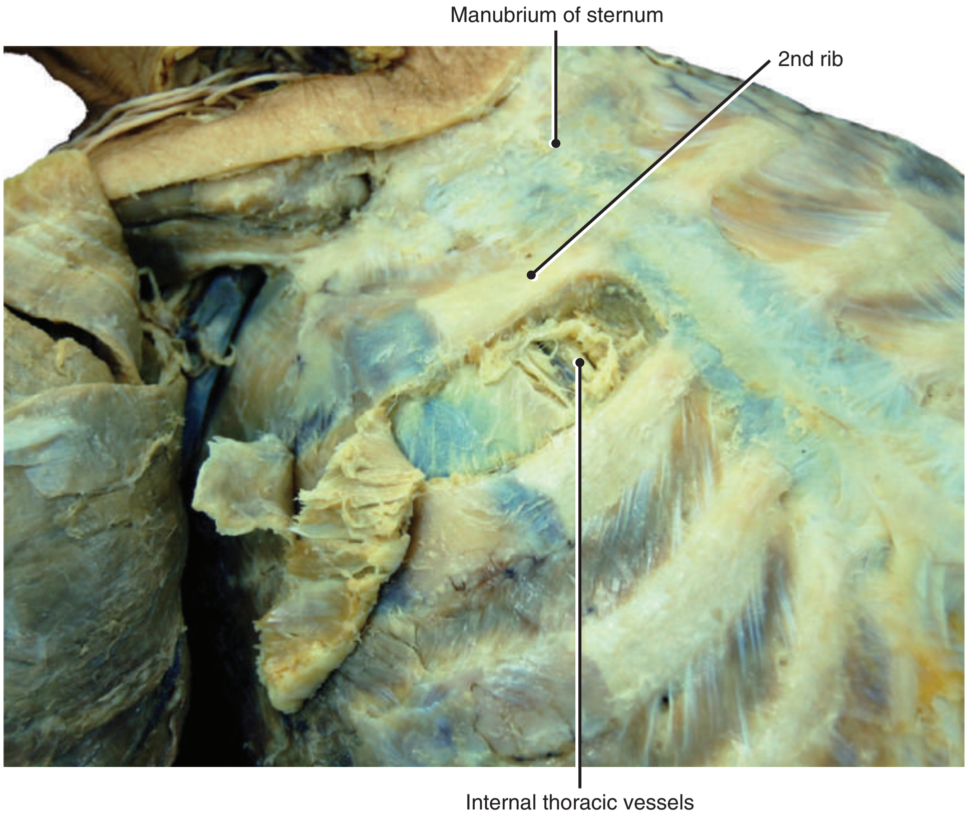
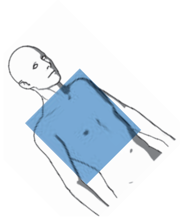

Manubrium of sternum
2nd rib
Internal thoracic vessels

Fig. 4.32 Anterior chest wall with reflected internal intercostal muscle and endothoracic fascia, revealing internal thoracic artery and vein.



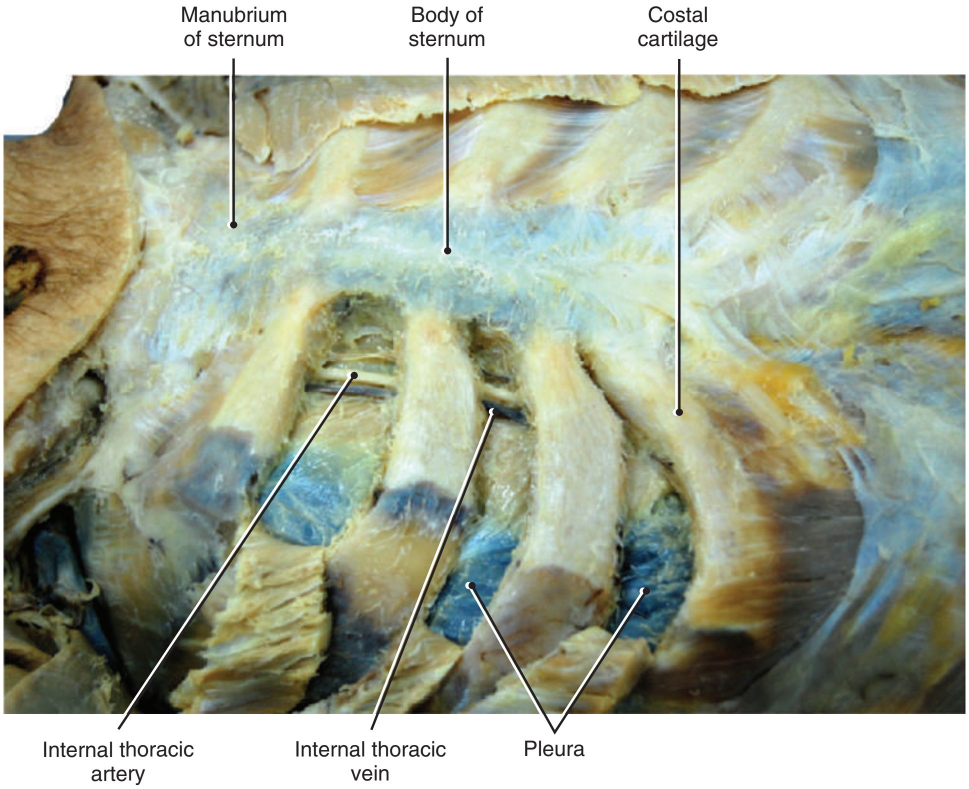
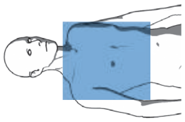

Manubrium of sternum
Body of sternum
Costal cartilage
Internal thoracic artery
Internal thoracic vein
Pleura

Fig. 4.33 Anterior chest wall with reflected internal intercostal muscle and endothoracic fascia, revealing internal thoracic artery and vein.



LABORATORY IDENTIFICATION CHECKLIST

Some of the nerves and arteries listed here will have been dissected during the laboratory for the superficial back (and upper limb) but also are seen when dissecting the breast.

NERVES

- ☐ Anterior cutaneous branches of intercostal
- ☐ Intercostobrachial (T2)
- ☐ Lateral cutaneous branches of intercostal (T3-T7)
- ☐ Lateral pectoral
- ☐ Medial pectoral
- ☐ Axillary
- ☐ Long thoracic
- ☐ Thoracodorsal
- ☐ Subscapular

ARTERIES

- ☐ Thoracoacromial
  - ☐ Pectoral branches
  - ☐ Deltoid branches
  - ☐ Clavicular branches
  - ☐ Acromial branches
- ☐ Internal thoracic
- ☐ Lateral thoracic
- ☐ Anterior intercostal
- ☐ Posterior intercostal

VEINS

- ☐ Axillary
- ☐ Internal thoracic
- ☐ Intercostal

MUSCLES

- ☐ Pectoralis major
  - ☐ Clavicular part
  - ☐ Sternal part
  - ☐ Abdominal part (not always present)
- ☐ Pectoralis minor
- ☐ Subclavius
- ☐ Serratus anterior
- ☐ External/internal intercostals

BONES

- ☐ Sternum
  - ☐ Manubrium
  - ☐ Body
  - ☐ Xiphoid process
  - ☐ Manubriosternal joint (angle of Louis, T4-T5)
- ☐ Clavicle
- ☐ 1st rib
- ☐ Ribs 2–12

LYMPHATICS

- ☐ Axillary nodes (generally 6 recognized nodal groups with total of 35–40 nodes)
- ☐ Internal thoracic node drainage (~5 per side)
- ☐ Thoracic duct

LIGAMENTS

- ☐ Suspensory ligaments (of Cooper)

BREAST

- ☐ Areolar-nipple complex
- ☐ Superficial fascia (from anterior chest wall)
- ☐ Lobes (15–20)
- ☐ Tail of breast (Spence)
- ☐ Deep fascia

ATLAS REFERENCES

Netter: 212–217
McMinn: 182–184, 192–211
Gray's Atlas: 72–92, 108–119

OPENING THE THORACIC CAVITY

- With a scalpel, transect the intercostal muscles, serratus anterior muscle, and a portion of the external abdominal oblique muscle (Figs. 5.1 and 5.2).
- Make sure that you start your dissection above the emergence of the intercostobrachial nerve (T2) and then descend toward the midaxillary line.
- With a saw or bone cutter, carefully cut the intercostal musculature from the first intercostal space lateral to the manubrium, then extend these incisions downward, just anterior to the emergence of the anterior cutaneous branches of the intercostal nerves, cutting the ribs and intercostal musculature down to the level of the 10th rib (Fig. 5.3).
- Divide the manubrium transversely above the sternal angle using a bone saw, cutters, or scalpel (Fig. 5.4).
- After making the saw cuts, use a scalpel and bone cutters or mallet and chisel to free the anterior thoracic wall (Fig. 5.5).

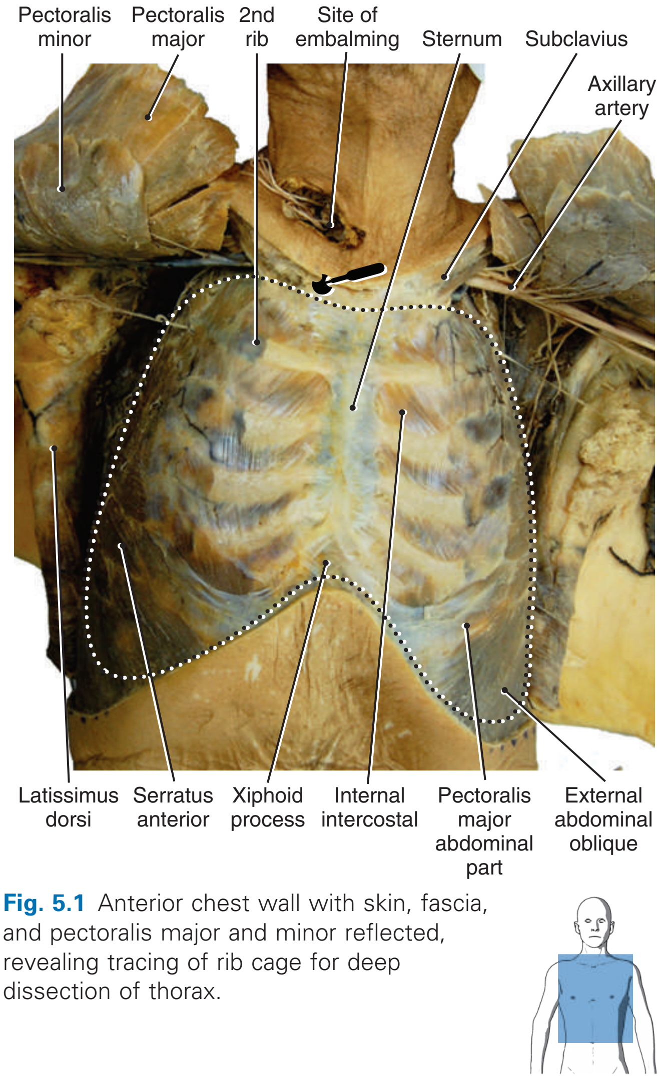

Pectoralis minor
Pectoralis major
2nd rib
Site of embalming
Sternum
Subclavius
Axillary artery
Latissimus dorsi
Serratus anterior
Xiphoid process
Internal intercostal
Pectoralis major abdominal part
External abdominal oblique

Fig. 5.1 Anterior chest wall with skin, fascia, and pectoralis major and minor reflected, revealing tracing of rib cage for deep dissection of thorax.

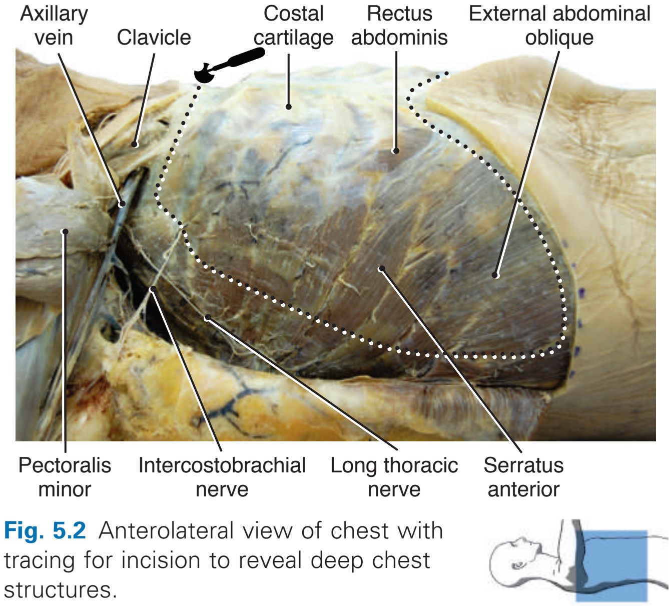

Axillary vein
Clavicle
Costal cartilage
Rectus abdominis
External abdominal oblique
Pectoralis minor
Intercostobrachial nerve
Long thoracic nerve
Serratus anterior

Fig. 5.2 Anterolateral view of chest with tracing for incision to reveal deep chest structures.

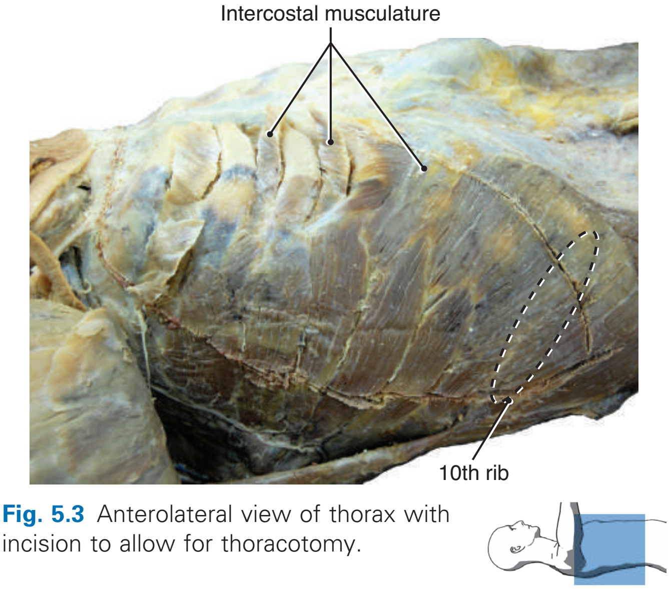

Intercostal musculature
10th rib

Fig. 5.3 Anterolateral view of thorax with incision to allow for thoracotomy.

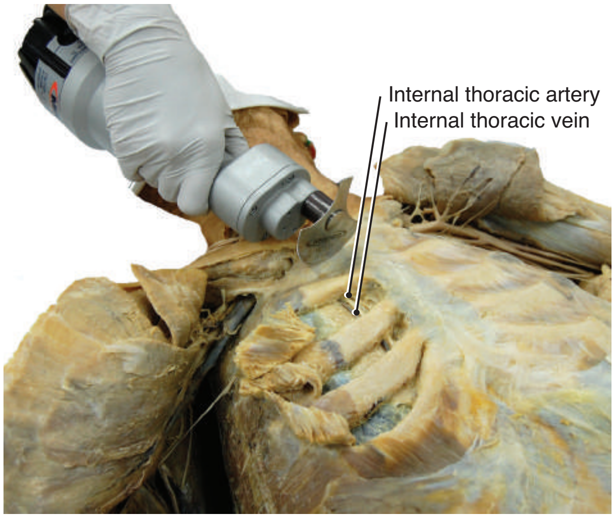
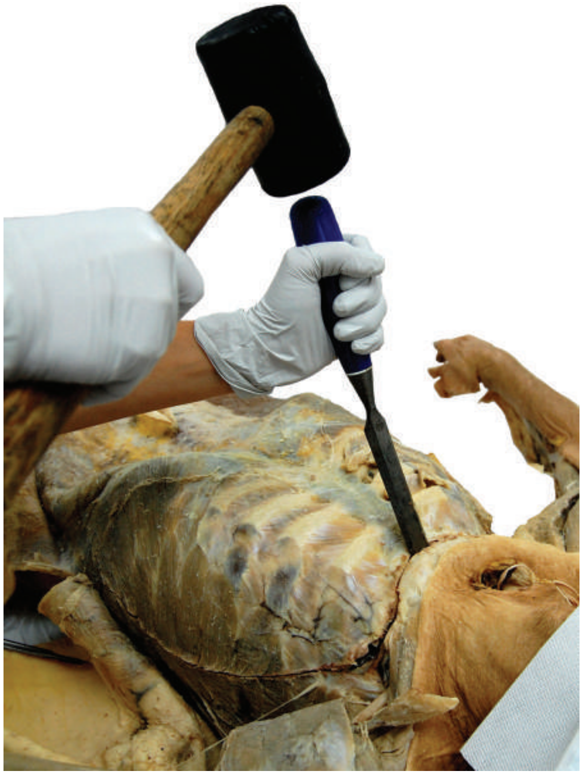


Fig. 5.4 Skin, fascia, and pectoral muscles reflected from anterior chest wall to reveal intercostal dissection of intercostal muscles, as well as internal thoracic artery and vein. Bone saw, cutters, or scalpel is used to make the bone incisions.



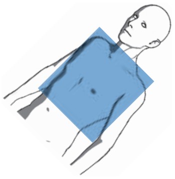
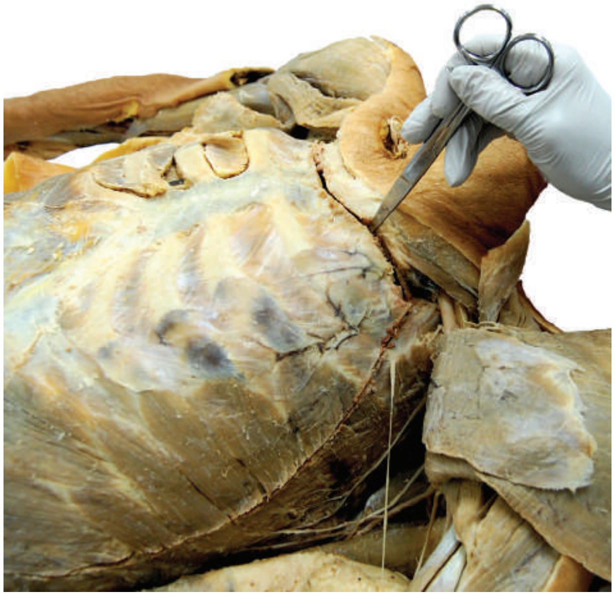


Fig. 5.5 Anterolateral view of chest with incision to reveal deep chest structures. Use mallet and chisel to release bone and connective tissue to allow removal of anterior chest wall plate.



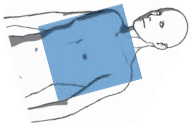


Fig. 5.6 Anterolateral view of chest with incision to reveal deep chest structures. Once bone and connective tissue have been transected, use blunt scissors to lift chest plate.

- **Once bone and connective tissue have been transected, use blunt scissors to lift the anterior thoracic wall. Try to avoid damage to the underlying lungs (Fig. 5.6).**

DISSECTION **TIP**

Often, in the first and second intercostal spaces, you will be able to place your fingertips underneath the internal surface of the anterior thoracic wall and lift it up (Fig. 5.7).

If some parts are still connected to the wall, use a scalpel and bone cutters to free the anterior thoracic wall (Fig. 5.8).

Be careful when you place your fingertips under the exposed ribs; sharp bone spicules are often present and may cause injury. Use a bone cutter or rongeur to remove these.

- **Place your fingertips underneath the openings of the thoracic wall and pull up (Fig. 5.9).**
- **If the internal thoracic vessels are still intact, cut them and then pull the chest wall inferiorly, exposing the thoracic contents.**
- **As you reflect the wall inferiorly, incise the parietal pleura from the internal surface of the anterior thoracic wall with a scalpel, leaving it intact over the lungs (Fig. 5.10).**
- **Cut the sternopericardial ligaments that connect the pericardial sac to the posterior surface of the sternum.**
- **Continue the reflection of the anterior thoracic wall downward until the thoracic viscerae can be clearly seen (Fig. 5.11).**

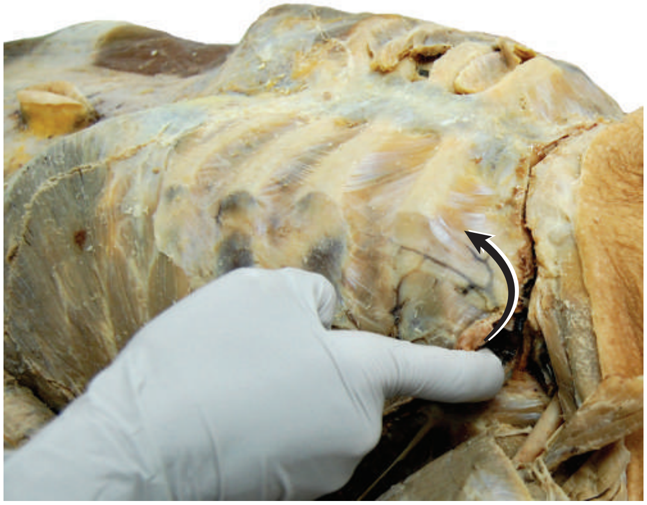
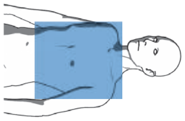


Fig. 5.7 Anterolateral chest wall can be removed manually.



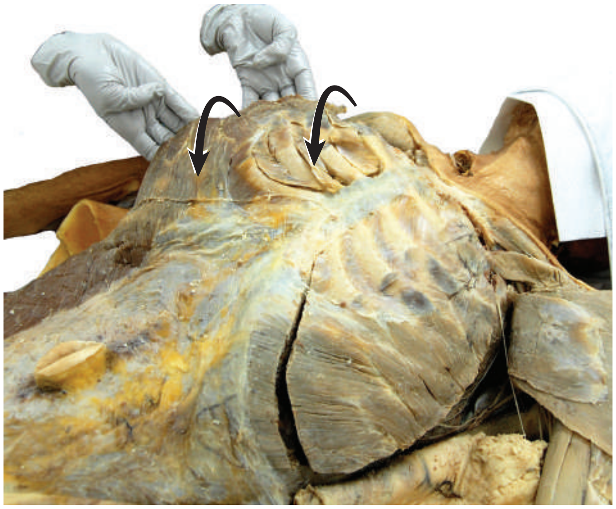
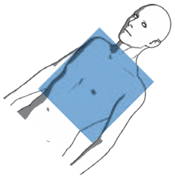


Fig. 5.9 Anterolateral chest wall reflected manually. Release connective tissue deep to anterior chest wall bilaterally.



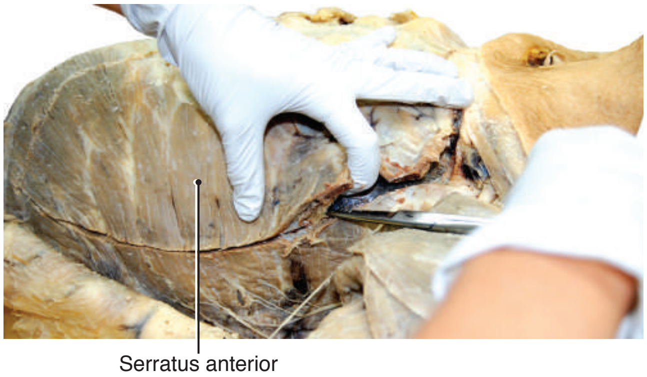
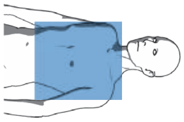

Serratus anterior

Fig. 5.8 Anterolateral view of thorax with incision to reveal deeper structures. Use blunt dissection with scissors to remove the chest wall.



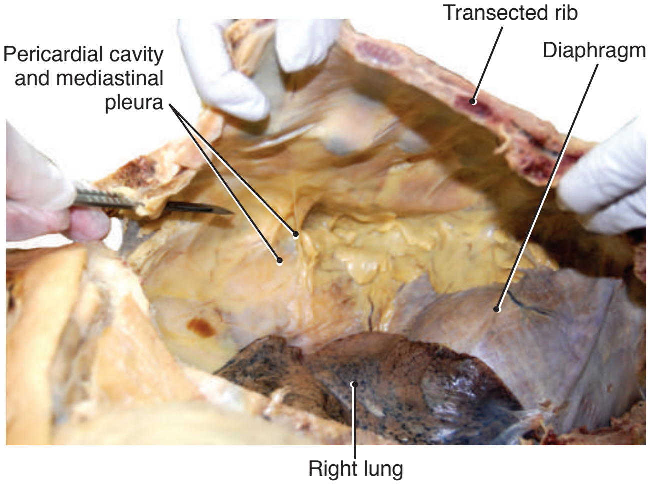
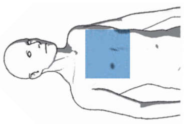

Transected rib
Pericardial cavity and mediastinal pleura
Diaphragm
Right lung

Fig. 5.10 Partial reflection of anterior chest wall plate, revealing deep structures.



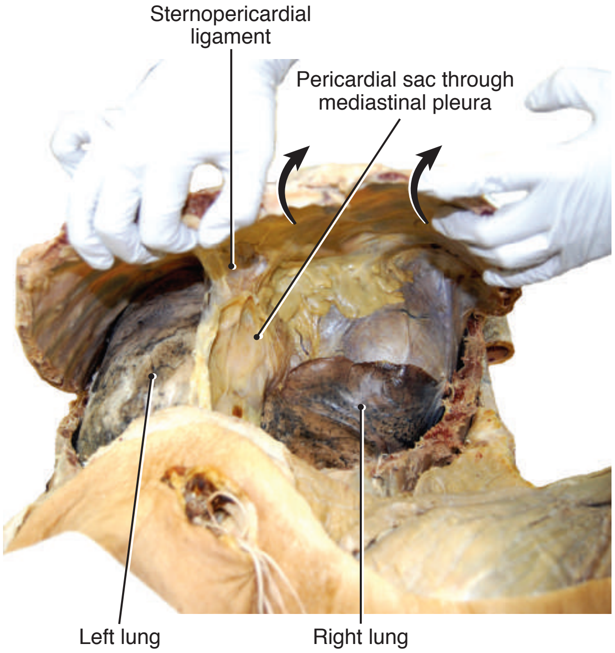
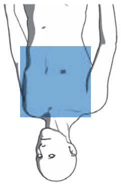

Sternopericardial ligament
Pericardial sac through mediastinal pleura
Left lung
Right lung

Fig. 5.11 Bilateral reflection of anterior chest wall plate, revealing deep internal structures.



- Keep the wall turned downward as the dissection proceeds (Fig. 5.12).
- Forcing the wall down usually results in sufficient stretching or tearing of tissues so that the anterior wall remains reflected inferiorly. If this is not the case, you can remove the anterior thoracic wall (Fig. 5.13). Using blunt dissection with your hand or blunt-ended scissors from superior to inferior helps guide the anterior connective tissue as desired.

DISSECTION **TIP**

The pleura is attached to the thoracic wall by a continuous layer of connective tissue, the endothoracic fascia. In some cadavers with previous pathology of the thorax, such as infections, the pleura may be thickened and adherent to the thoracic walls, making efforts to preserve it difficult.

- Observe the internal surface of the anterior thoracic wall, and identify the internal thoracic arteries and veins and their branches (Fig. 5.14).
- Reflect the parietal pleura to expose the intercostal muscles.
- Reflecting the parietal pleura in the 1st and 2nd intercostal spaces exposes the internal thoracic artery. Identify it.
- To expose the internal thoracic artery and vein further, reflect the transversus thoracis muscles.

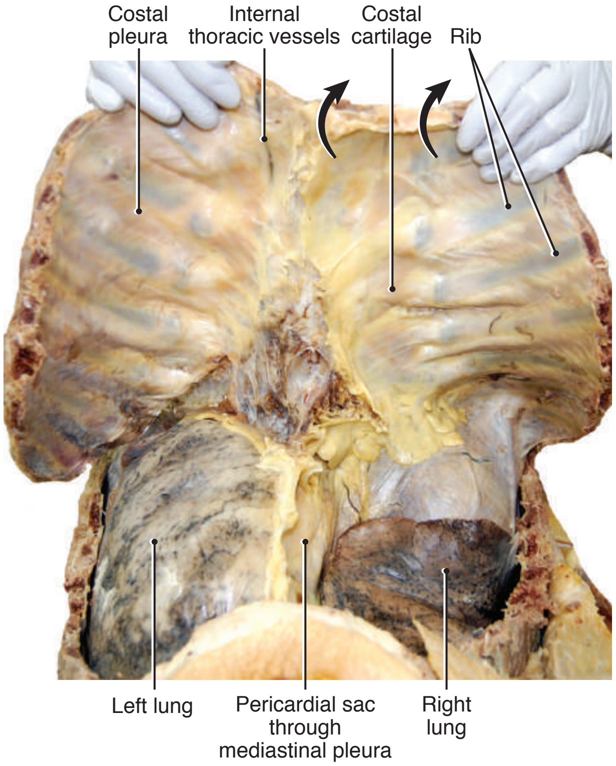
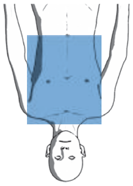

Costal pleura
Internal thoracic vessels
Costal cartilage
Rib
Left lung
Pericardial sac through mediastinal pleura
Right lung

Fig. 5.12 Bilateral reflection of anterior chest wall, revealing deep internal structures.



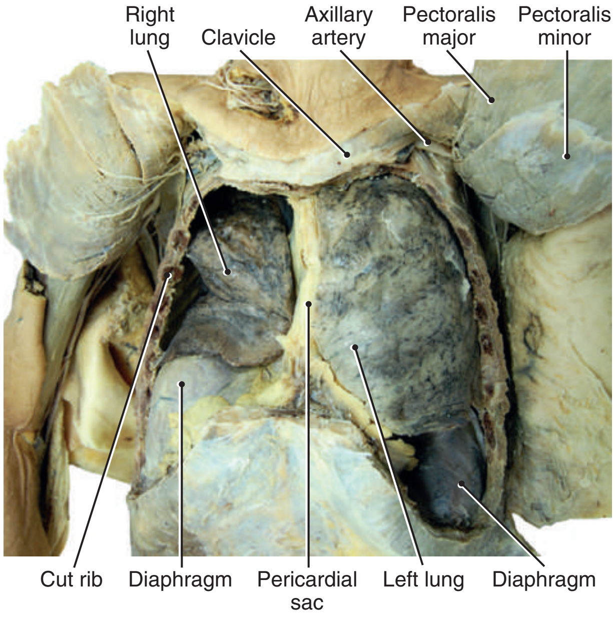
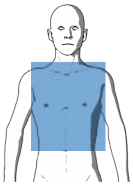

Right lung
Clavicle
Axillary artery
Pectoralis major
Pectoralis minor
Cut rib
Diaphragm
Pericardial sac
Left lung
Diaphragm

Fig. 5.13 Anterior thoracic wall removed, revealing internal thoracic structures. Note that the right lung is collapsed. This is probably due to a pneumothorax that occurred during life.



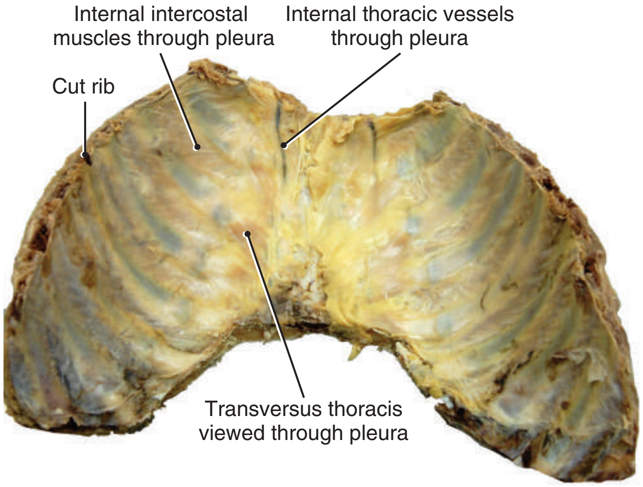

Internal intercostal muscles through pleura
Internal thoracic vessels through pleura
Cut rib
Transversus thoracis viewed through pleura

Fig. 5.14 Undersurface of removed chest plate, revealing structures intimate with the chest plate.

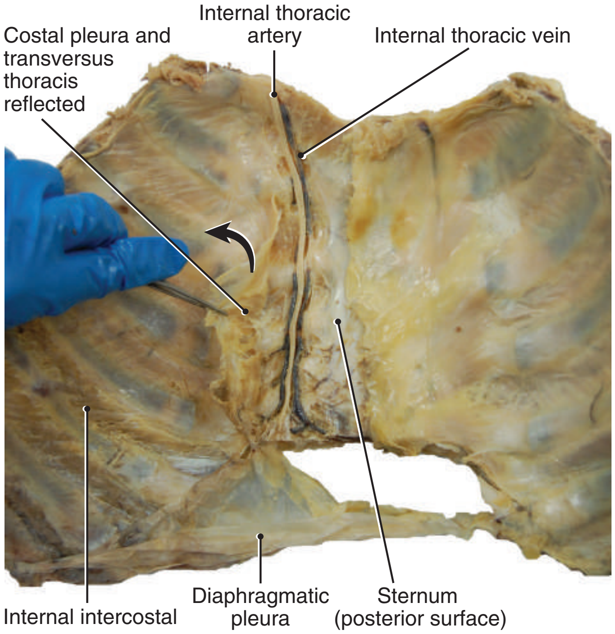

Costal pleura and transversus thoracis reflected
Internal thoracic artery
Internal thoracic vein
Internal intercostal
Diaphragmatic pleura
Sternum (posterior surface)

Fig. 5.15 Undersurface of removed chest wall, highlighting internal thoracic artery.

- ○ Identify the branches of the internal thoracic artery, such as the perforating and anterior intercostal branches (Fig. 5.15).

ANATOMY **NOTE**

Typically, the terminal branches of the internal thoracic artery—the superior epigastric and musculophrenic branches—are located close to the xiphoid process.

- ○ Identify the costodiaphragmatic and costomediastinal recesses.
- ○ After inspecting the subdivisions of the parietal pleura, push the lung away from the heart with your fingertips.
- ○ Identify the mediastinal pleura separating the lung from the pericardial sac.

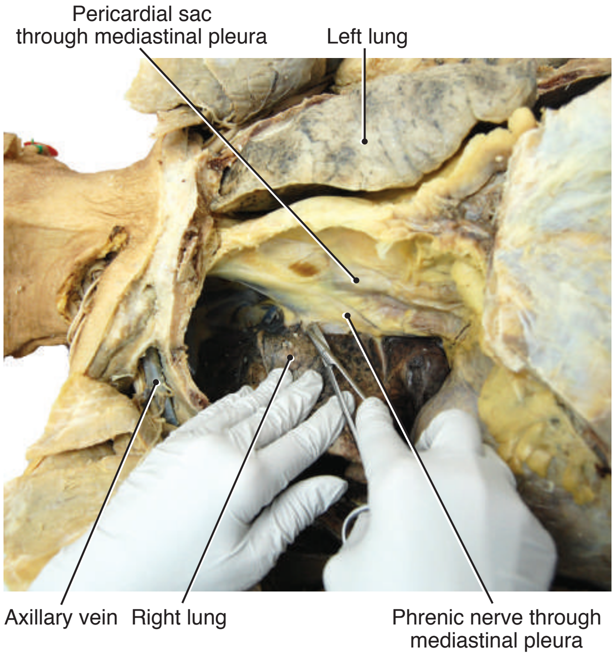
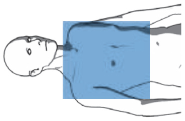

Pericardial sac through mediastinal pleura
Left lung
Axillary vein
Right lung
Phrenic nerve through mediastinal pleura

Fig. 5.16 Anterior thoracic structures with right lung reflected to expose mediastinum to dissect for lung removal.



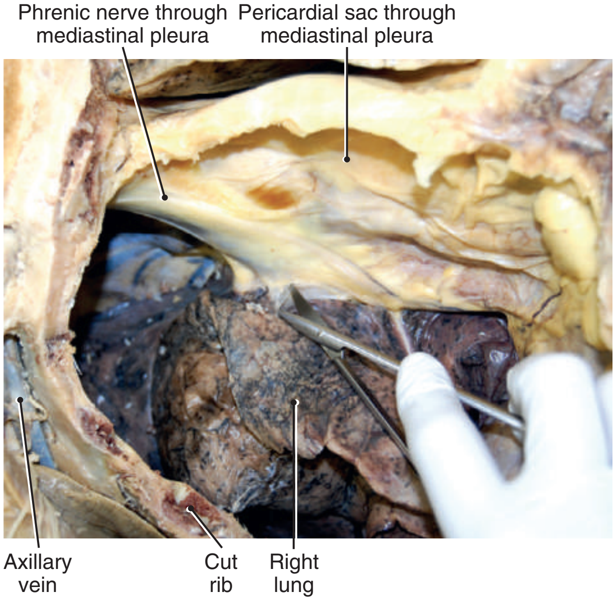
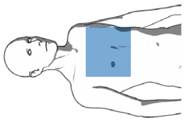

Phrenic nerve through mediastinal pleura
Pericardial sac through mediastinal pleura
Axillary vein
Cut rib
Right lung

Fig. 5.17 Anterior chest structures with right lung reflected to expose mediastinum.



- ○ Insert the scissors and separate the mediastinal pleura from the pericardium (Figs. 5.16 and 5.17).
- ○ Identify the phrenic nerve traveling anterior to the hilum of the lung and preserve it (Fig. 5.18).
- ○ Use the separation technique to expose the pulmonary arteries and veins (Fig. 5.19).

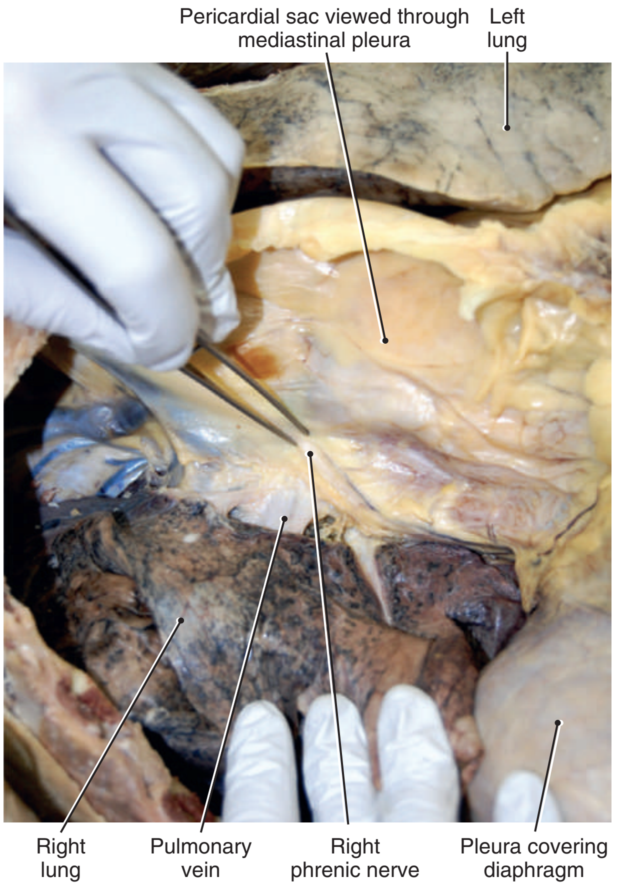
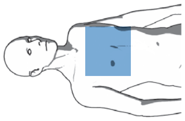

Pericardial sac viewed through mediastinal pleura
Left lung
Right lung
Pulmonary vein
Right phrenic nerve
Pleura covering diaphragm

Fig. 5.18 Anterior chest structures with right lung reflected to reveal mediastinum, highlighting phrenic nerve through the mediastinal pleura.



- ○ **Use the same technique for the contralateral lung (Figs. 5.20 and 5.21).**

DISSECTION **TIP**

The costodiaphragmatic recess is usually the location where excess embalming fluids accumulate during dissection. Drain the fluid using a syringe, and place paper towels into the recess (Figs. 5.22 and 5.23). Also, once the lungs are removed, holes can be made in the posterior intercostal spaces so that fluid exits onto the dissection table. This method may necessitate placing a wedge or block under the thorax to lift the body slightly off of the dissecting table.

- ○ **After exposing the pulmonary veins, pulmonary arteries, and primary bronchi at the hila of the left and right lungs, transect them with scissors or a scalpel (Figs. 5.24, 5.25, 5.26, and Plate 5.1).**
- ○ **Remove the lungs from the thoracic cavity, and observe the posterior mediastinum covered with parietal pleura (Figs. 5.27 to 5.30).**

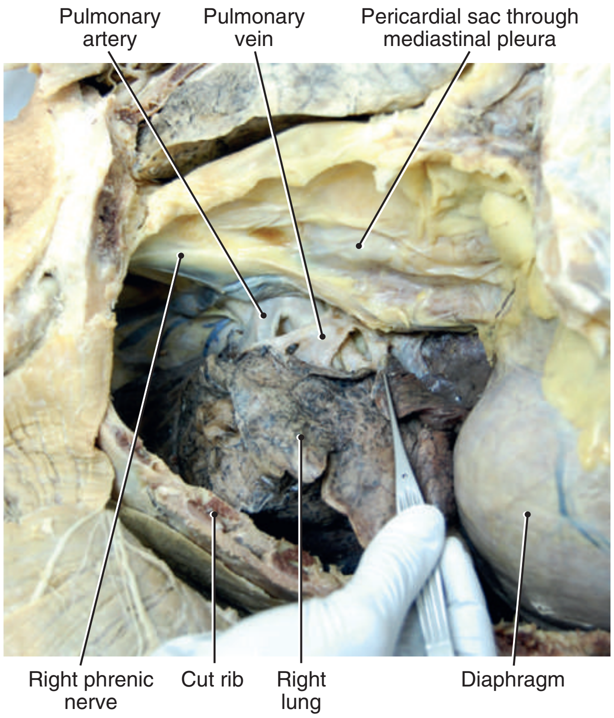
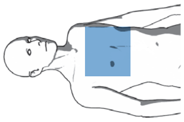

Pulmonary artery
Pulmonary vein
Pericardial sac through mediastinal pleura
Right phrenic nerve
Cut rib
Right lung
Diaphragm

Fig. 5.19 In the right pleural cavity, the pulmonary artery and vein are seen.



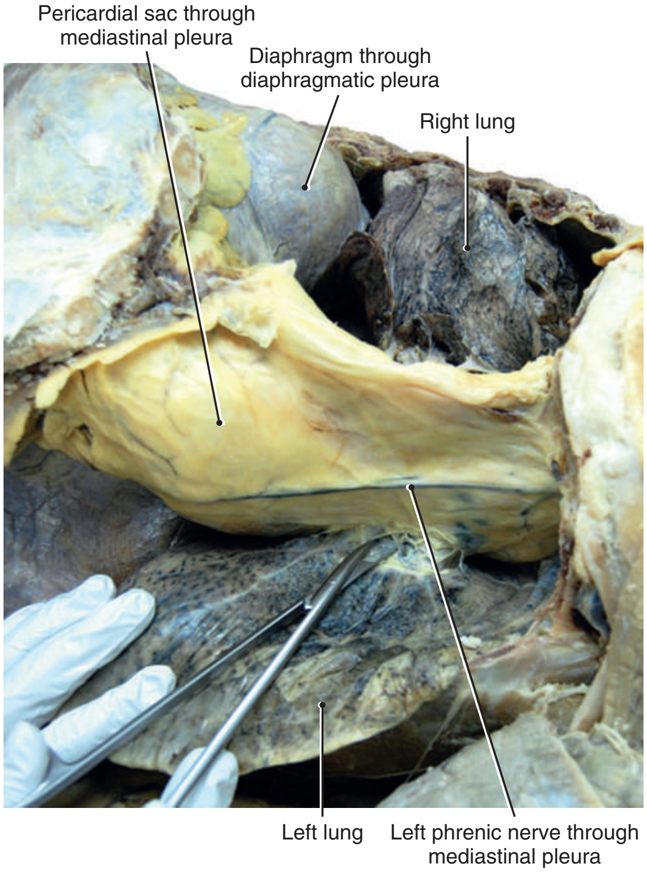
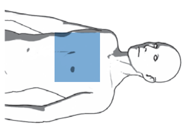

Pericardial sac through mediastinal pleura
Diaphragm through diaphragmatic pleura
Right lung
Left lung
Left phrenic nerve through mediastinal pleura

Fig. 5.20 Anterior thoracic structures with left lung reflected for hilar dissection.



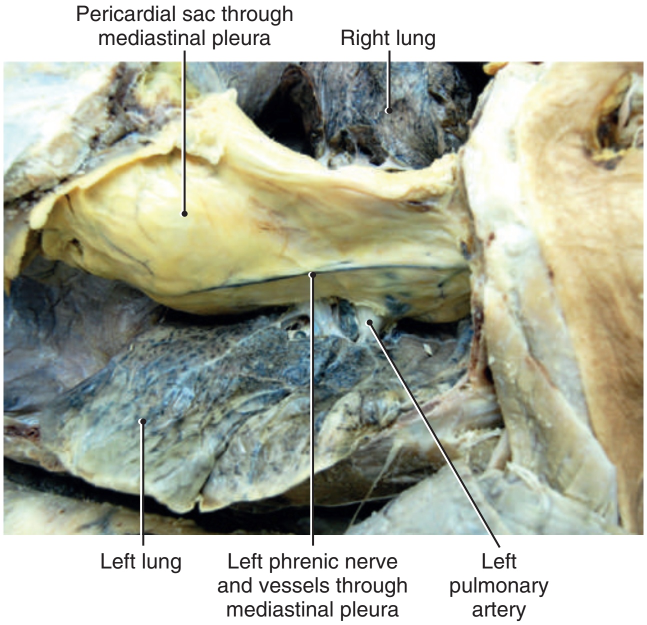

Pericardial sac through mediastinal pleura
Right lung
Left lung
Left phrenic nerve and vessels through mediastinal pleura
Left pulmonary artery

Fig. 5.21 Anterior thoracic structures with left lung reflected for hilar dissection, revealing pulmonary vessels.

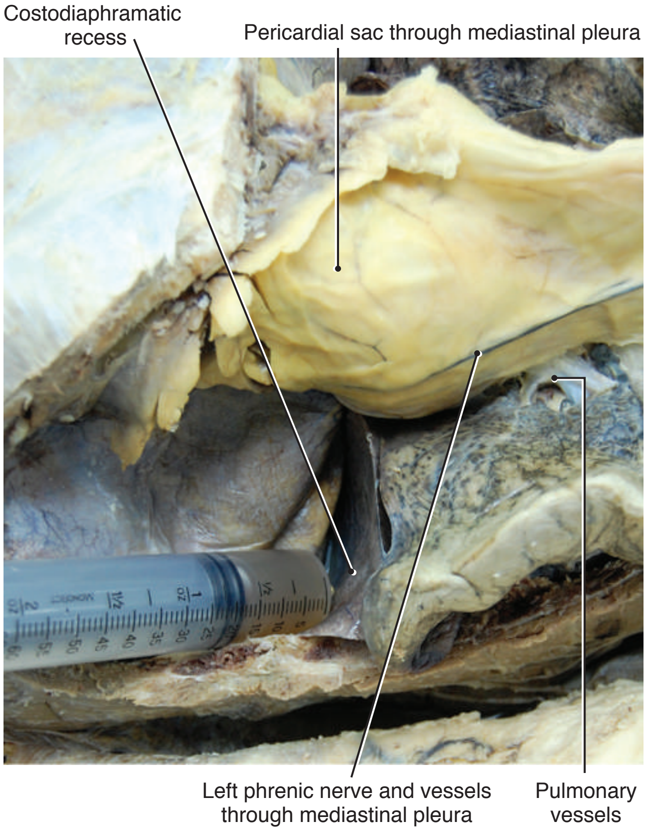

Costodiaphramatic recess
Pericardial sac through mediastinal pleura
Left phrenic nerve and vessels through mediastinal pleura
Pulmonary vessels

Fig. 5.22 Anterolateral view of deep chest dissection. Syringe is placed into the costodiaphragmatic recess, and excess fluid is aspirated.

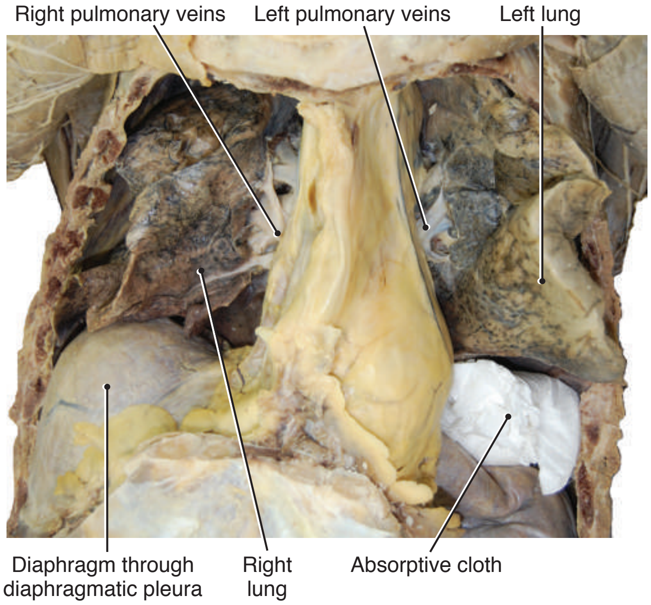

Right pulmonary veins
Left pulmonary veins
Left lung
Diaphragm through diaphragmatic pleura
Right lung
Absorptive cloth

Fig. 5.23 Anterior thoracic wall removed, revealing deep structures. Right and left pulmonary veins are exposed.

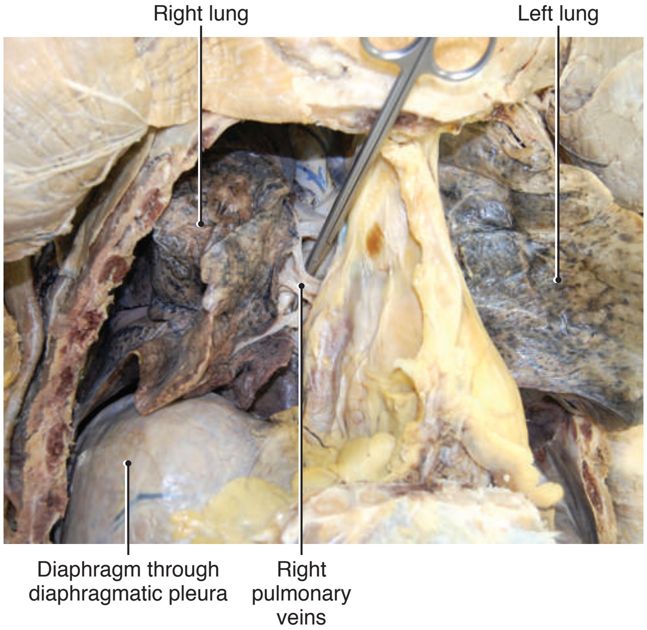

Right lung
Left lung
Diaphragm through diaphragmatic pleura
Right pulmonary veins

Fig. 5.24 Right pulmonary vein exposed and lifted upward for transection.

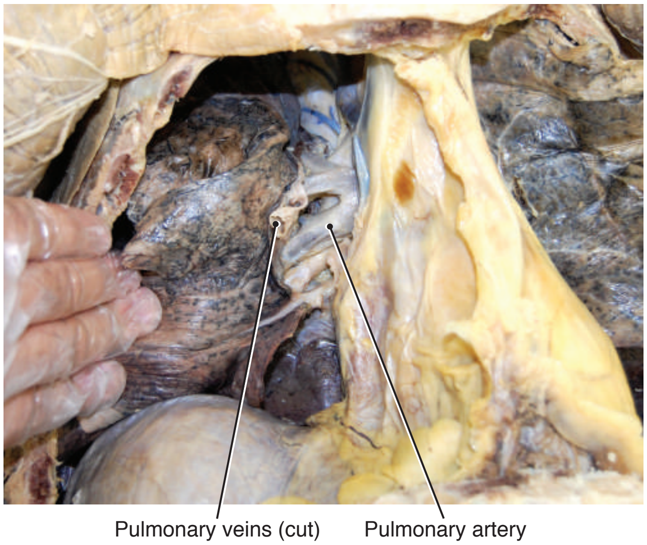
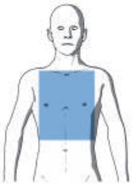

Pulmonary veins (cut)
Pulmonary artery

Fig. 5.25 Right lung retraction revealing pulmonary artery after pulmonary veins have been cut.



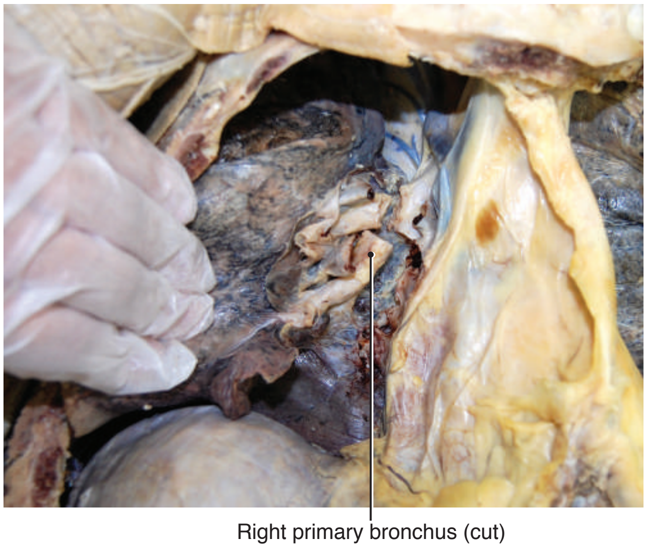
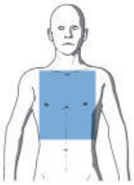

Right primary bronchus (cut)

Fig. 5.26 Right lung pulmonary vasculature and airway (primary bronchus) transected.



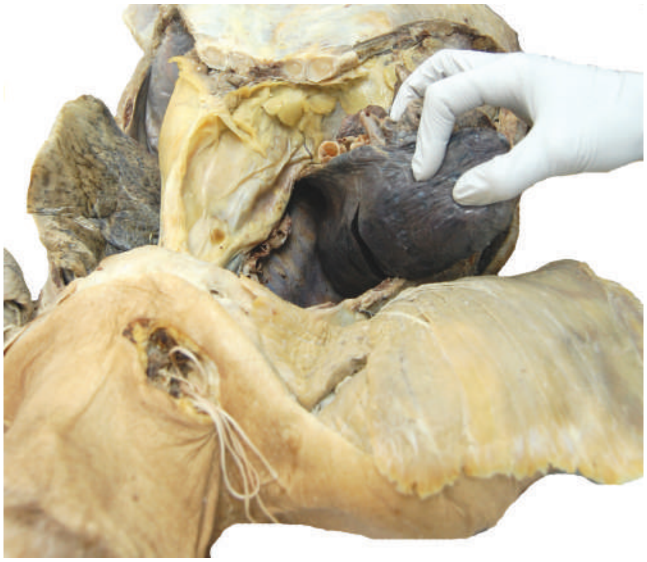
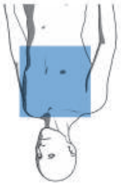


Fig. 5.27 Removal of right lung from superior to inferior with medial retraction.



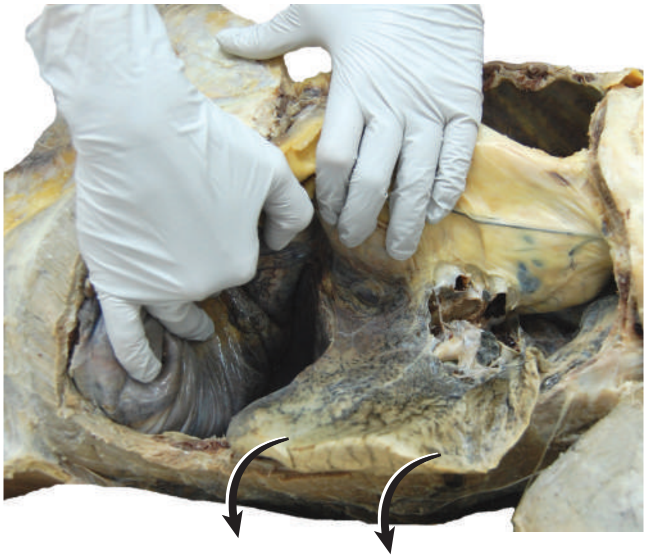
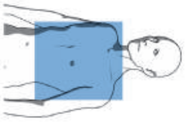


Fig. 5.28 Removal of left lung with pulmonary vasculature and bronchi transected, using medial retraction.



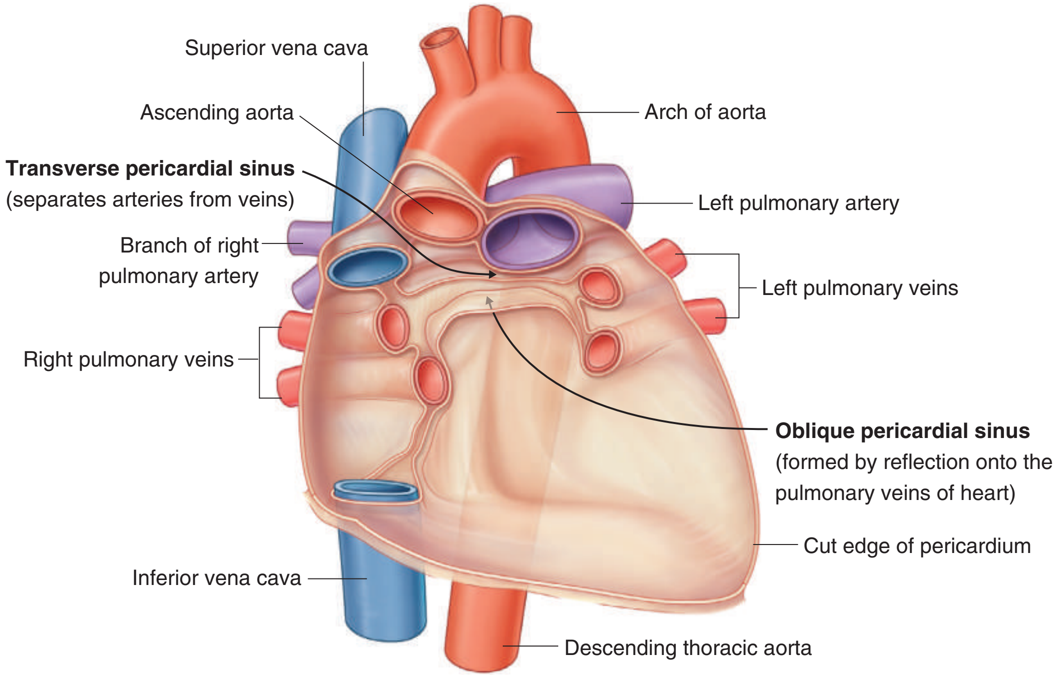

Superior vena cava
Ascending aorta
Arch of aorta
Transverse pericardial sinus
(separates arteries from veins)
Left pulmonary artery
Branch of right
pulmonary artery
Left pulmonary veins
Right pulmonary veins
Oblique pericardial sinus
(formed by reflection onto the
pulmonary veins of heart)
Cut edge of pericardium
Inferior vena cava
Descending thoracic aorta

Plate 5.1 Pericardial sac with heart removed.

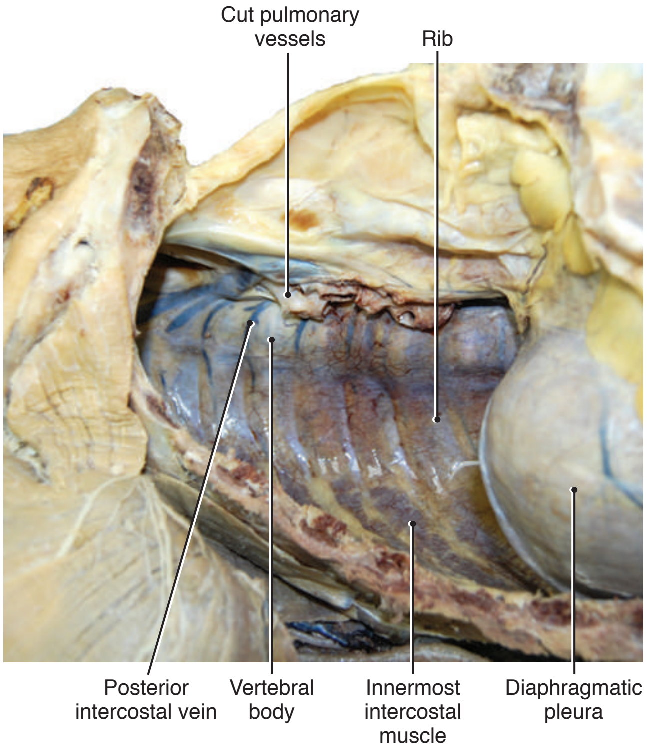
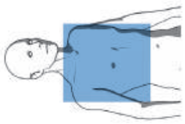

Cut pulmonary
vessels
Rib
Posterior
intercostal vein
Vertebral
body
Innermost
intercostal
muscle
Diaphragmatic
pleura

Fig. 5.29 Right hemithorax with lung removed, revealing vertebral column and posterior chest wall.



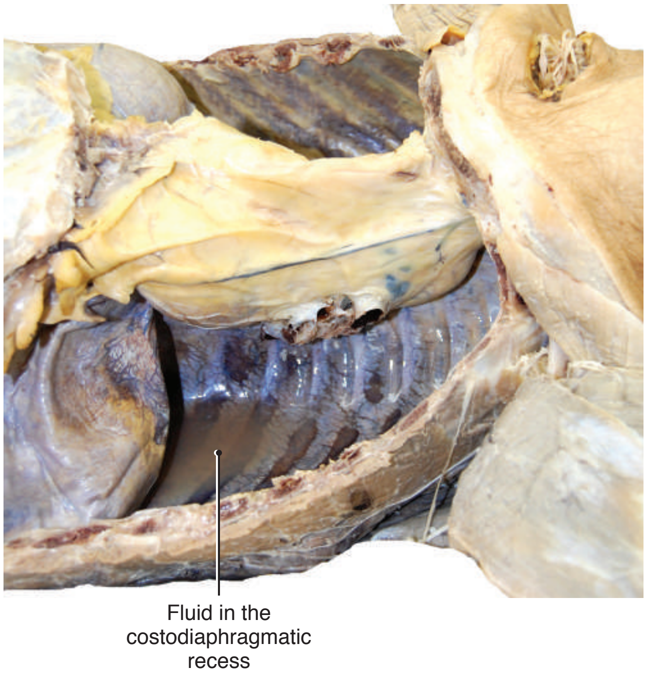
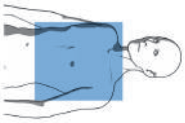

Fluid in the
costodiaphragmatic
recess

Fig. 5.30 Bilateral lung removal with intact pericardial sac and contents.



DISSECTION TIP

Often the lungs have adhesions far inferior and posterior to the hilum of the lung. To remove the lung completely, push the diaphragm inferiorly and explore with your fingertips the area posterior and inferior to the hilum so that such adhesions can be dissected free (see Fig. 5.30).

- **Place the lungs onto a tray, and examine the internal surface of each lung separately. For the right lung, identify the oblique and horizontal fissures and their corresponding upper, middle, and lower lobes (Fig. 5.31).**
- **Inspect the hilum of the lung, and identify the pulmonary arteries, pulmonary veins, and primary bronchi (Fig. 5.32).**

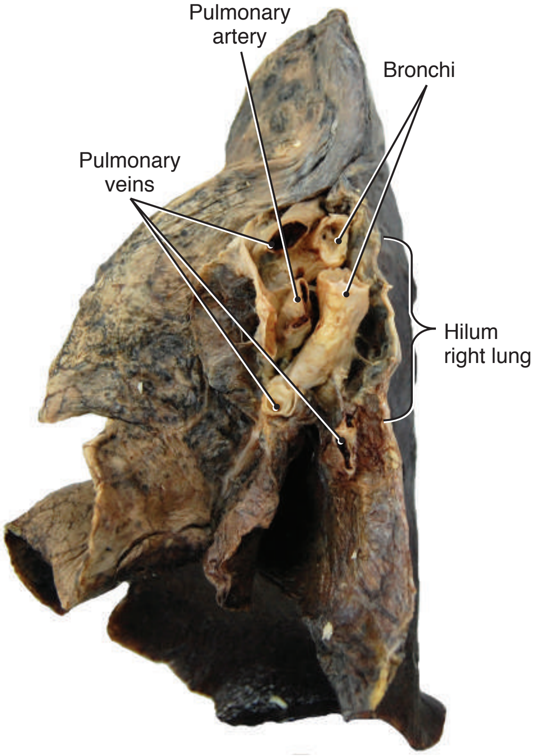

Pulmonary artery
Bronchi
Pulmonary veins
Hilum right lung

Fig. 5.32 Right lung (medial view) highlighting structures of the hilum.

DISSECTION TIP

Note that the horizontal fissure often appears to be incomplete in right lungs. To identify the pulmonary arteries and pulmonary veins at the hilum of the lung, note that the pulmonary veins are located along the anterior aspect of the hilum, where the pulmonary arteries usually are located superior and anterior to the bronchi (see Fig. 5.32).

- **Similar to the right lung, identify the oblique fissure in the left lung and the corresponding upper and lower lobes (Fig. 5.33).**

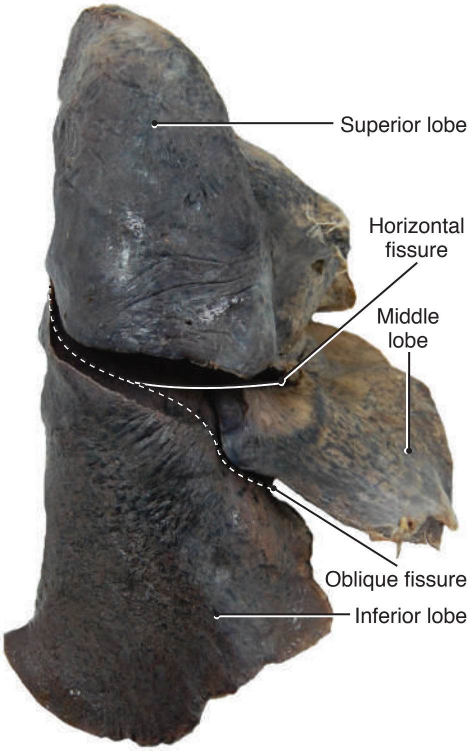

Superior lobe
Horizontal fissure
Middle lobe
Oblique fissure
Inferior lobe

Fig. 5.31 Right lung with anterolateral surfaces.

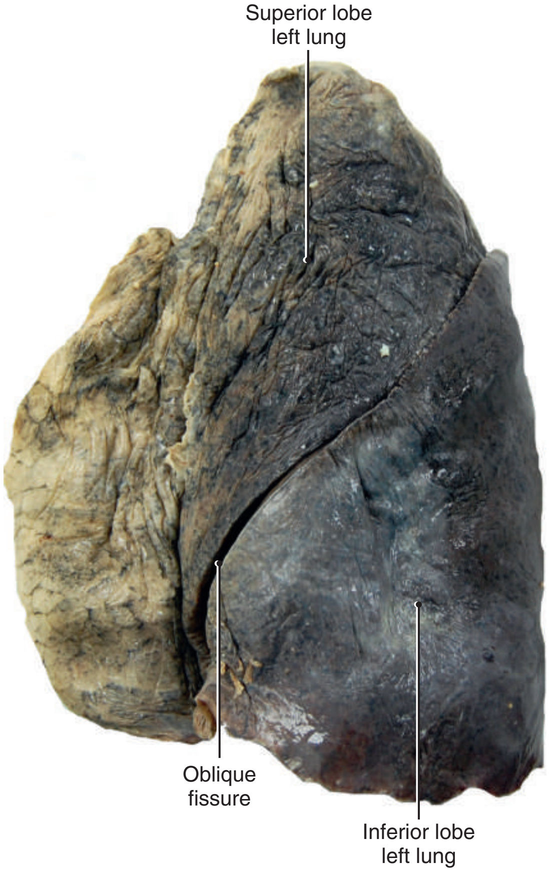

Superior lobe left lung
Oblique fissure
Inferior lobe left lung

Fig. 5.33 Left lung.

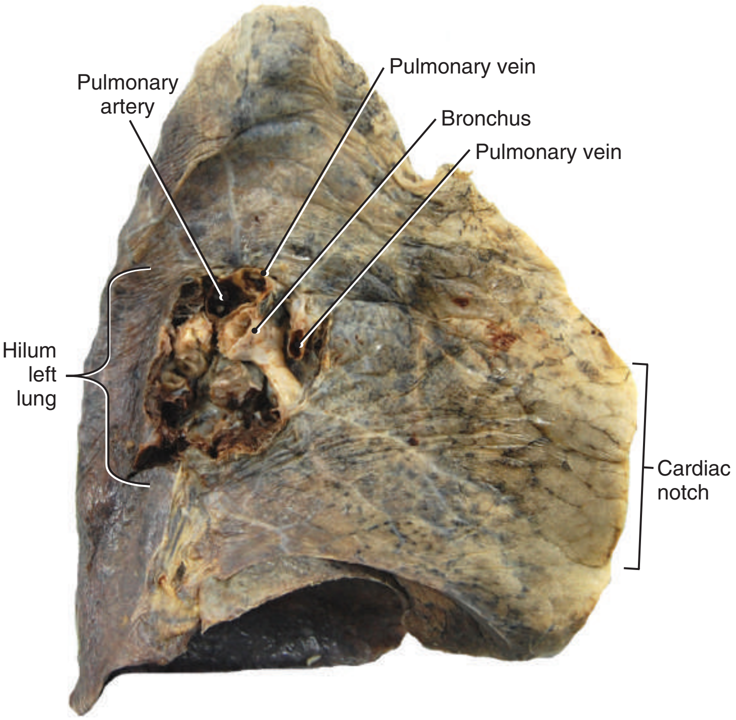


Fig. 5.34 Removal of left lung with medial view highlighting hilum structures.

- Inspect the hilum of the lung, and identify the pulmonary arteries, pulmonary veins, and primary bronchi (Fig. 5.34).
- Identify the cardiac notch on the superior lobe of the left lung and lingula.
- Inferior to the hilum, trace the two layers of visceral pleura fusing together to form the pulmonary ligament (Fig. 5.35).

OPTIONAL LUNG DISSECTION

ANATOMY **NOTE**

The lung contents can be dissected to expose a single segmental bronchus, segmental artery, and segmental vein. The portion of lung supplied by the segmental bronchus, artery, and vein is defined as a *bronchopulmonary segment.*

- With your forceps, lift the bronchus, and using blunt dissection, separate it from the lung parenchyma.
- Remove most of the internal lung parenchyma with your forceps and scissors, leaving its borders and lateral walls intact (Fig. 5.36).
- In the right lung, you will be able to dissect the superior, middle, and inferior lobar bronchi.

ANATOMY **NOTE**

Each lobar bronchus branches off into several segmental bronchi, and each of these supplies one bronchopulmonary segment. The right lung contains 10 to 12 bronchopulmonary segments, and the left lung contains 10.

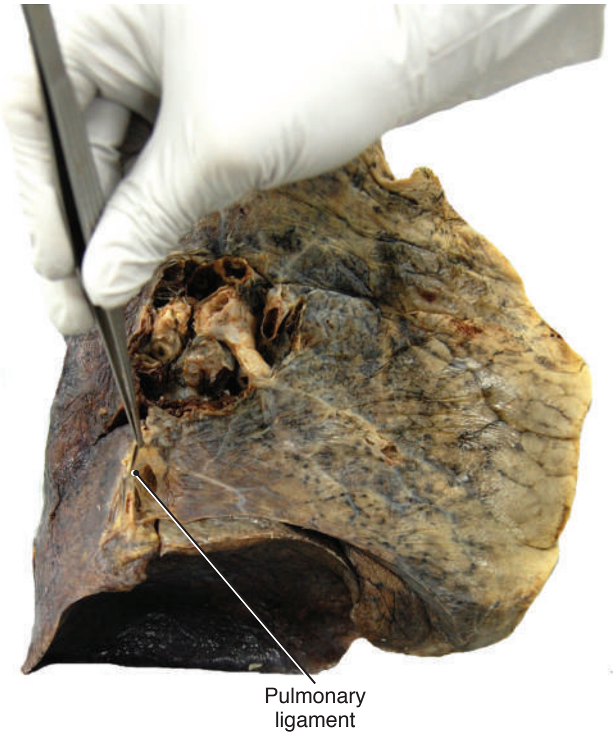


Fig. 5.35 Removal of left lung with medial view highlighting pulmonary ligament.

ANATOMY **NOTE**

When you reach a bronchopulmonary segment, note the relationships among the artery, vein, and bronchus. The segmental arteries are located posterior to the segmental bronchi, and the segmental veins are between two adjacent bronchopulmonary segments.

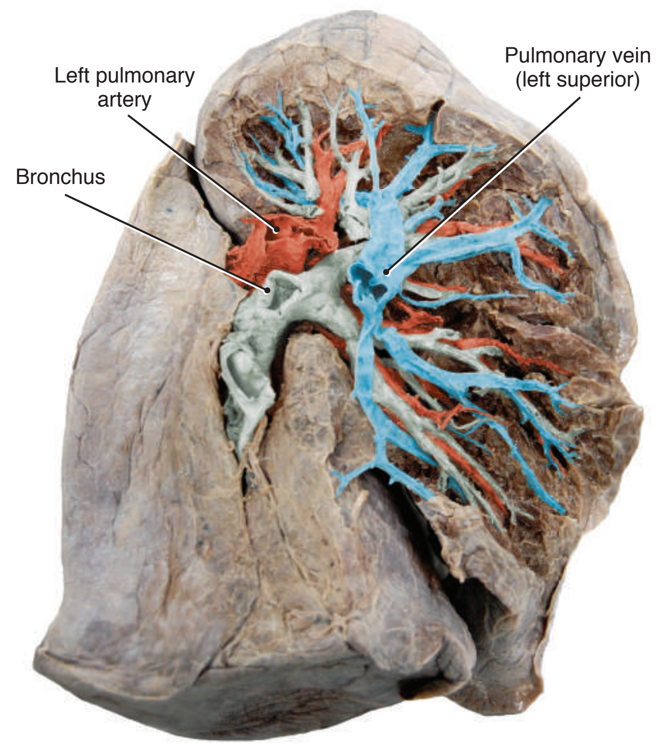


Fig. 5.36 Removal of left lung with medial view illustrating bronchopulmonary segments.

ANATOMY **NOTE**

As it passes superior to the right pulmonary artery, the right superior lobar bronchus is termed the *eparterial bronchus.*

REMOVAL OF THE HEART

- Before removing the heart from the pericardial cavity, the phrenic nerves must be identified and preserved. Observe the pericardiacophrenic vein at the lateral border of the pericardial sac bilaterally.
- Dissect the pericardium next to the pericardiacophrenic vein, and identify the phrenic nerve (Figs. 5.37 and 5.38).

ANATOMY **NOTE**

The phrenic nerve is accompanied by the pericardiacophrenic artery, a branch of the internal thoracic artery.

- Dissect the phrenic nerve along its entire length, from the top of the thoracic cavity to its penetration of the diaphragm (Figs. 5.39 and 5.40).
- With toothed forceps, lift the right inferolateral edge of the pericardium near the diaphragm, and make a small incision (Fig. 5.41).
- Note the attachment of the pericardium to the central tendon of the diaphragm.
- Make a transverse incision in the pericardium parallel to the diaphragmatic surface (Fig. 5.42).

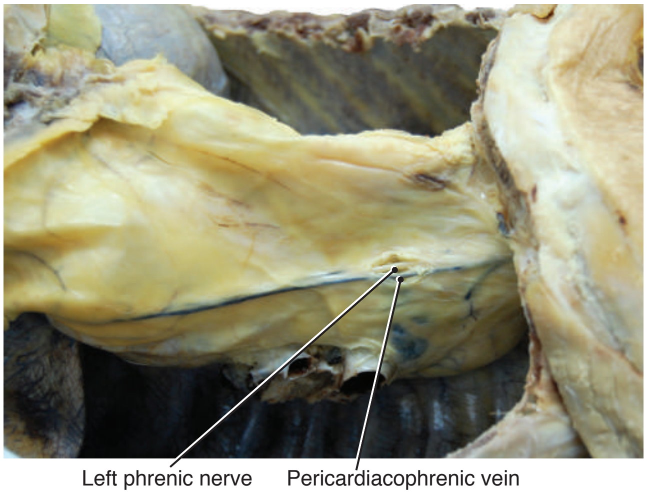
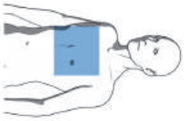


Fig. 5.37 Bilateral lung removal with intact pericardial sac and contents.



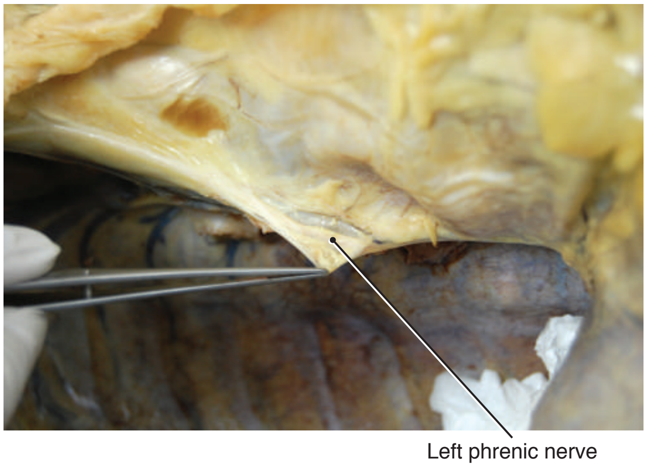
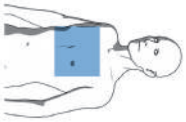


Fig. 5.38 Left hemithorax with intact pericardial sac, revealing left phrenic nerve.



DISSECTION **TIP**

When the pericardial sac is first opened, a small amount of serous fluid is often seen.

- Make a second, connecting vertical incision through the pericardium along the side of the right atrium (Fig. 5.43) and along the side of the left ventricle (Fig. 5.44).
- Note that the parietal pericardium and the visceral pericardium (epicardium) are continuous with the great vessels as they pierce the fibrous pericardium.

EXTERNAL INSPECTION

- For orientation of the heart within the pericardial cavity, observe the position of the right atrium, right

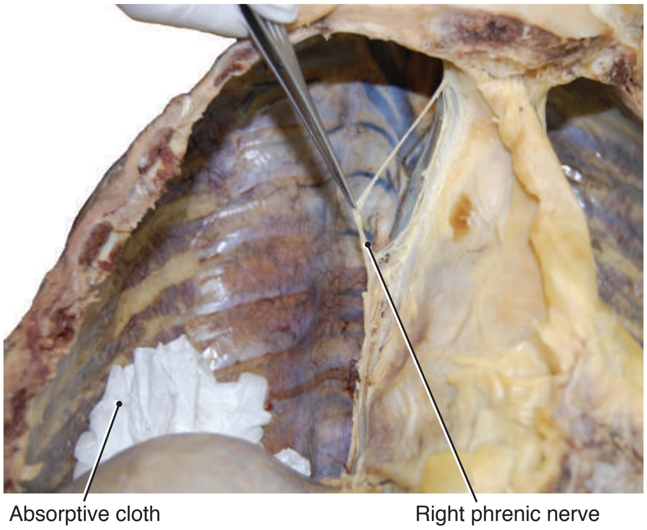
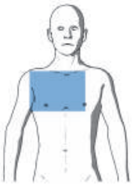

Absorptive cloth
Right phrenic nerve

Fig. 5.39 Bilateral lung removal with intact pericardial sac and contents, exposing the right phrenic nerve.



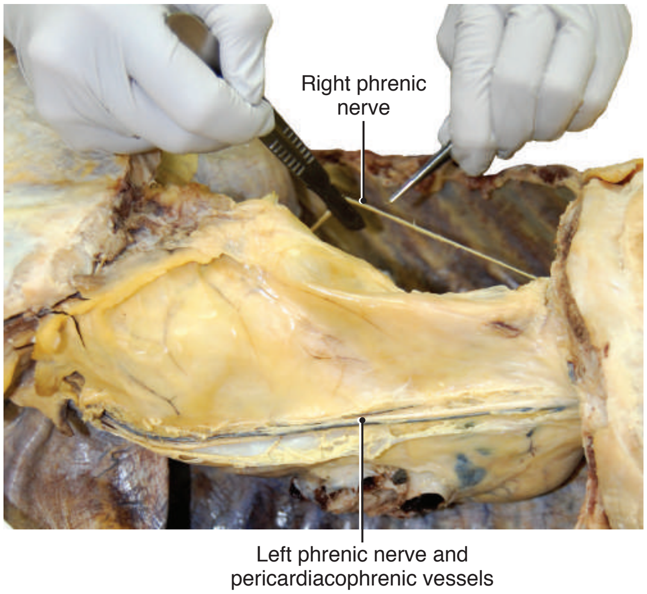
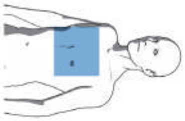

Right phrenic nerve
Left phrenic nerve and pericardiacophrenic vessels

Fig. 5.40 Intact pericardial sac and contents with dissected phrenic nerve and pericardiacophrenic vessels.



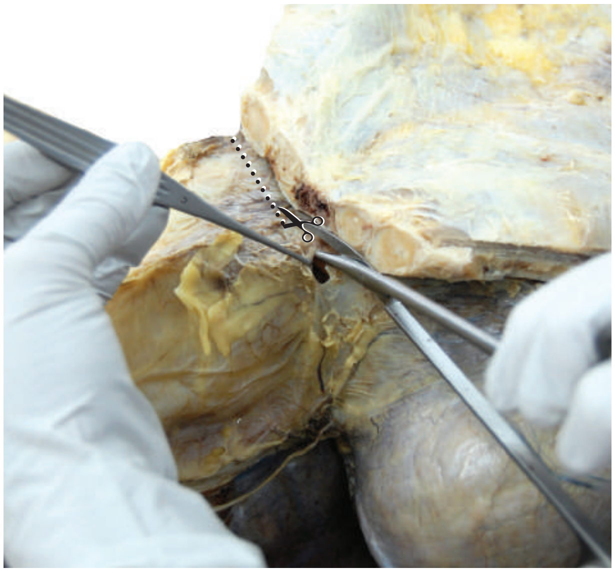
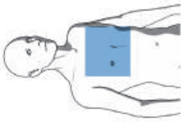


Fig. 5.41 Anterior view of pericardial sac with tracing for transverse incision *(dotted line)* of pericardial sac.



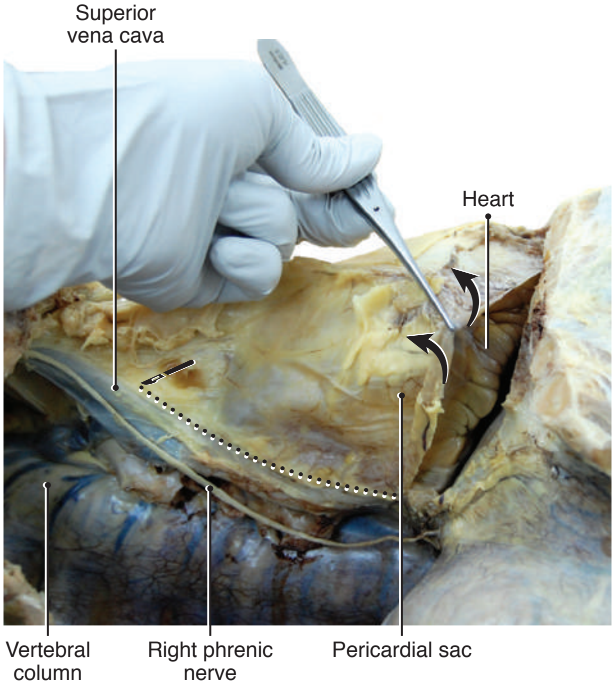
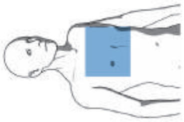

Superior vena cava
Heart
Vertebral column
Right phrenic nerve
Pericardial sac

Fig. 5.42 Anterolateral view of pericardial sac with base reflected (black arrows) and tracing for lateral vertical incision *(dotted line).*



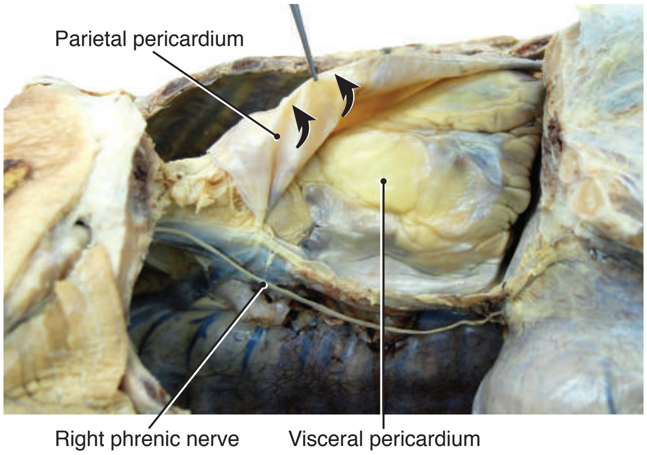
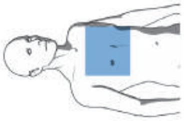


Fig. 5.43 Reflected pericardial sac revealing visceral pericardium of heart.



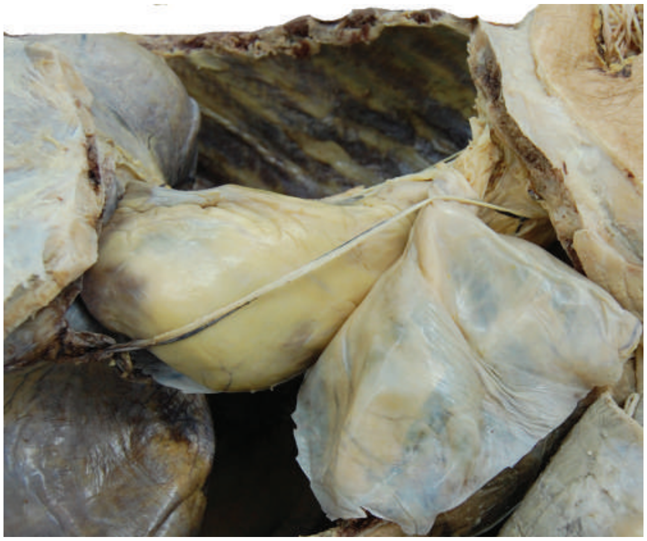
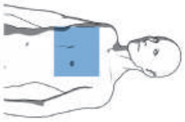


Fig. 5.44 Anterolateral reflection of pericardial sac while maintaining an intact left phrenic nerve.



auricle, right ventricle and its outflow tract, and pulmonary trunk. Note the left atrium, left ventricle and apex of the heart, and anterior and posterior interventricular grooves.

ANATOMY **NOTE**

The right ventricle forms the sternocostal surface and part of the diaphragmatic surface of the heart. The left or pulmonary surface is composed mainly of the left ventricle. The right ventricle forms the sternocostal surface and part of the diaphragmatic surface of the heart. Note that the right ventricle is the most anterior part of the heart and is almost in contact with the sternum.

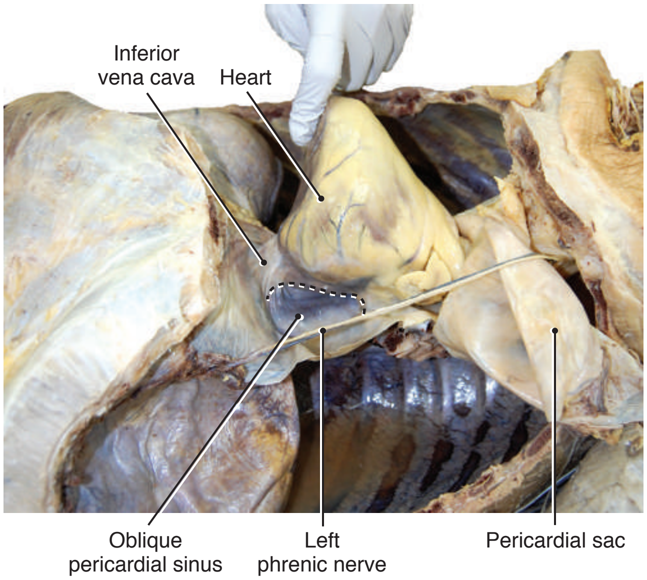
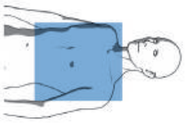


Fig. 5.45 Reflected pericardial sac with apex of heart reflected anteriorly to reveal the oblique sinus *(dotted line).*



SINUSES

ANATOMY **NOTE**

Note the position of the inferior vena cava, which is located inferior and to the right between the heart and the diaphragm.

ANATOMY **NOTE**

The reflections of the pericardium lead to the formation of two so-called sinuses within the pericardial cavity, the transverse and oblique pericardial sinuses.

- **To identify the oblique pericardial sinus, lift the apex of the heart laterally and to the right with your fingertips, and expose the blindly ending space in the pericardial cavity behind the heart and below the venous hilum (Fig. 5.45).**

ANATOMY **NOTE**

The venous hilum contains the four pulmonary veins and the superior and inferior vena cava. The sleeve-like investment of visceral pericardium around these vessels and the roof of the left atrium reflects to show the parietal pericardial sac, forming the inverted, U-shaped oblique sinus.

- **If you place your fingers in front of the atria and directly behind the aorta and pulmonary artery, you will occupy the space known as the *transverse pericardial sinus* (Fig. 5.46).**

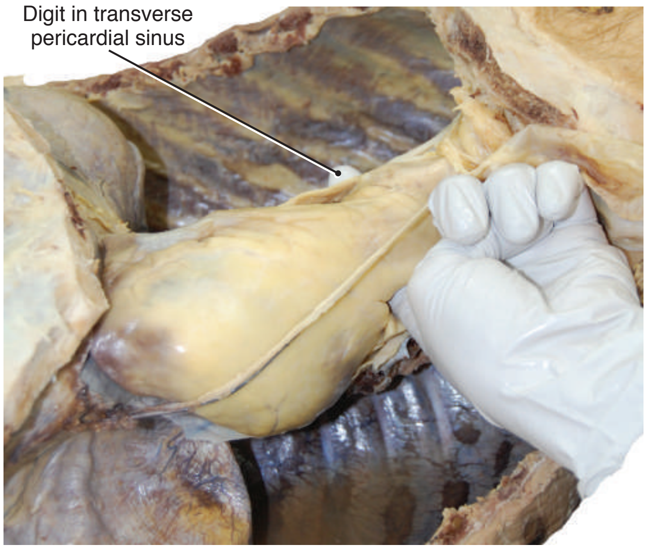
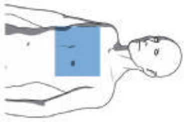

Digit in transverse pericardial sinus

Fig. 5.46 Reflected pericardial sac with placement of digit through transverse sinus.



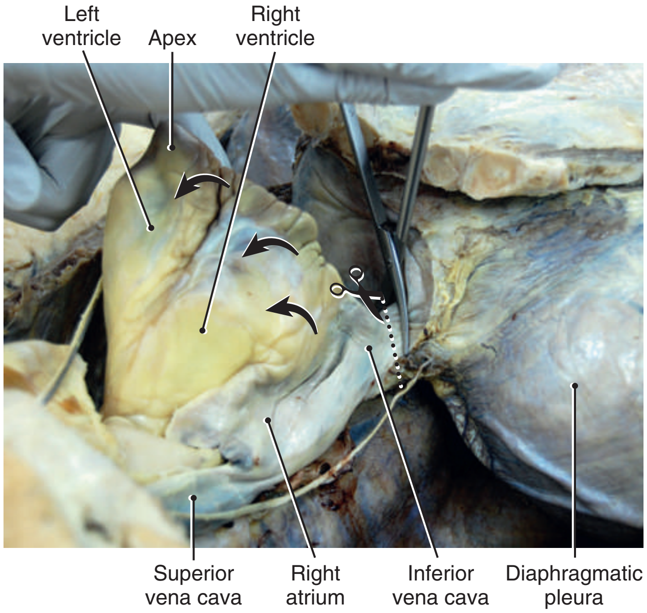
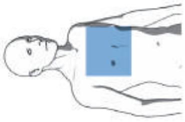

Left ventricle
Apex
Right ventricle
Superior vena cava
Right atrium
Inferior vena cava
Diaphragmatic pleura

Fig. 5.47 Apex of heart reflected anteriorly to allow transection of inferior vena cava.



TECHNIQUE

- **To remove the heart, first lift its apex upward and expose the inferior vena cava, then transect it (Figs. 5.47 and 5.48).**
- **With scissors, separate the adhesions between the heart (posteriorly) and pericardium, and lift the heart upward to expose the left atrium (Figs. 5.49 and 5.50).**
- **Cut the superior vena cava. Next, cut the ascending aorta and the pulmonary trunk (Figs. 5.51 to 5.53). Remove the heart from the pericardial cavity.**

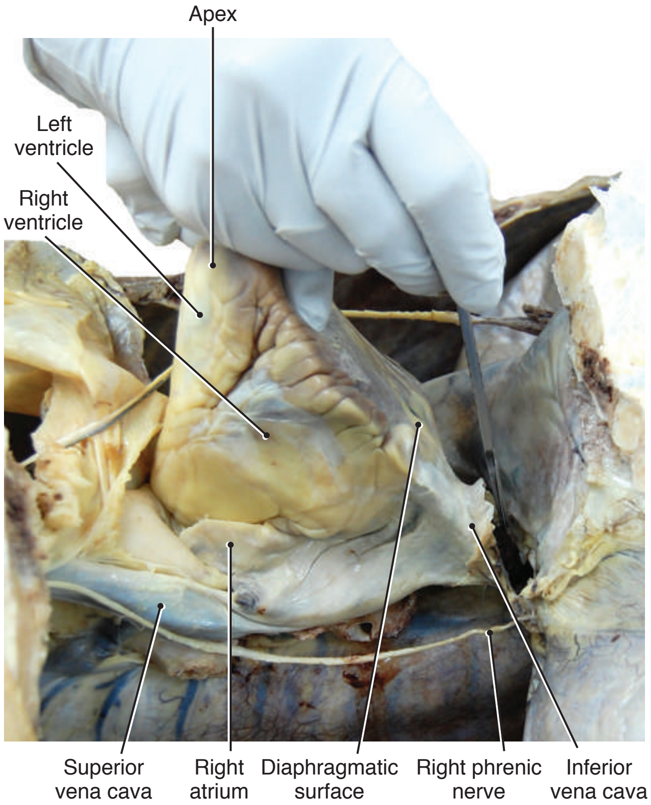
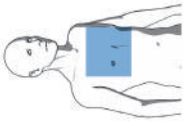

Apex
Left ventricle
Right ventricle
Superior vena cava
Right atrium
Diaphragmatic surface
Right phrenic nerve
Inferior vena cava

Fig. 5.48 Apex of heart reflected anteriorly to allow transection of inferior vena cava.



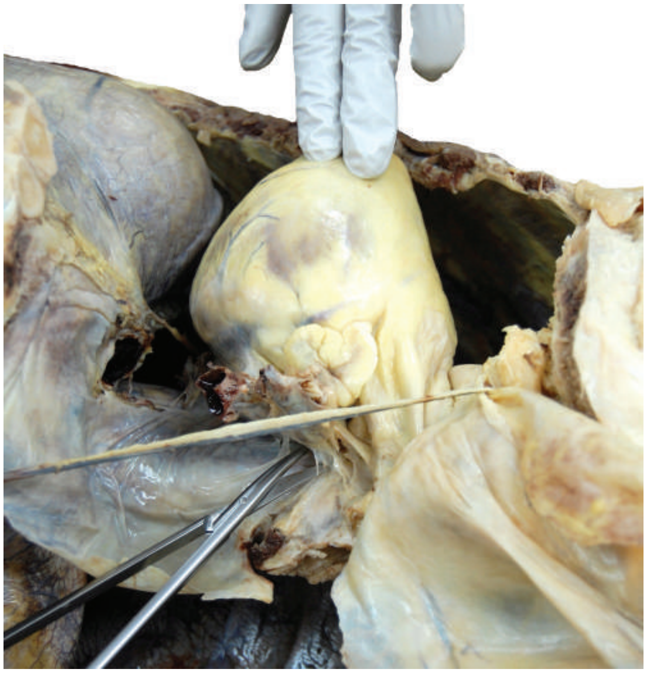
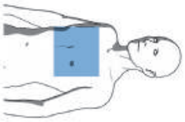


Fig. 5.49 With the apex of the heart elevated, scissors are used to separate the pericardium from the posterior surface of heart.



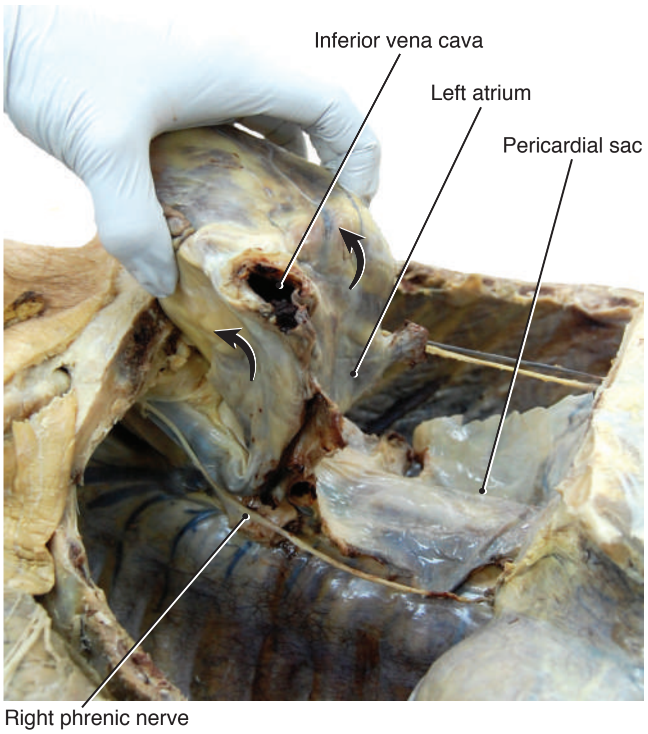
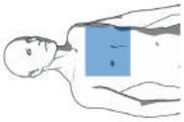

Inferior vena cava
Left atrium
Pericardial sac
Right phrenic nerve

Fig. 5.50 Apex of heart reflected anterosuperiorly, revealing cut inferior vena cava, left atrium, and posterior pericardial structures.



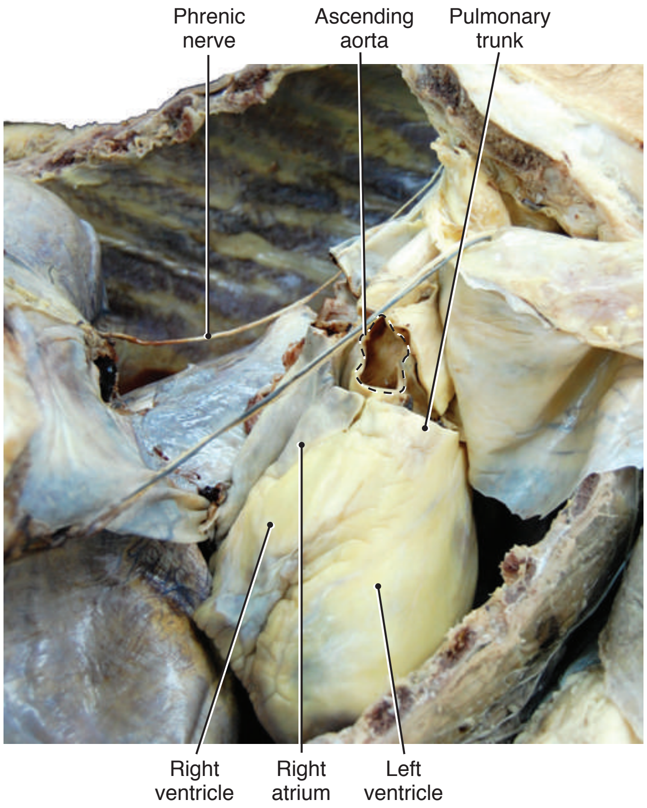

Phrenic nerve
Ascending aorta
Pulmonary trunk
Right ventricle
Right atrium
Left ventricle

Fig. 5.52 External view of heart with transected great vessels.

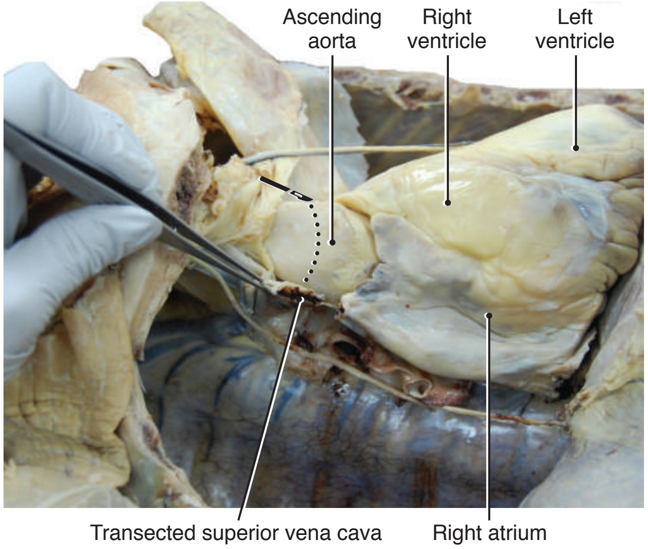
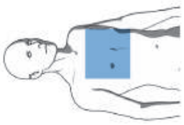

Ascending aorta
Right ventricle
Left ventricle
Transected superior vena cava
Right atrium

Fig. 5.51 With the pericardial sac displaced laterally and the superior vena cava cut, the ascending aorta is identified. The *dotted line* notes the region of the aorta to be transected.



DISSECTION **TIP**

In some hearts, the pulmonary veins are adherent to the pericardium. Place some tension on the heart and lift it upward. If necessary, place the scissors between the pulmonary veins and the pericardium and separate the two.

- **Observe the left side of the thoracic cavity, specifically the lateral side of the aortic arch and the pulmonary trunk (Figs. 5.54 and 5.55).**
- **Identify and trace the left vagus nerve over the arch of the aorta (Fig. 5.56). Note the relationship between the vagus and phrenic nerves.**

ANATOMY **NOTE**

Identify the ligamentum arteriosum, the connection between the left pulmonary artery and the arch of the aorta. Identify the trachea and its bifurcation into the left and right bronchi. The vagus nerves give rise to the recurrent laryngeal nerves. On the left side, as the nerve crosses the aorta, it gives rise to the recurrent laryngeal nerve (Figs. 5.57 and 5.58).

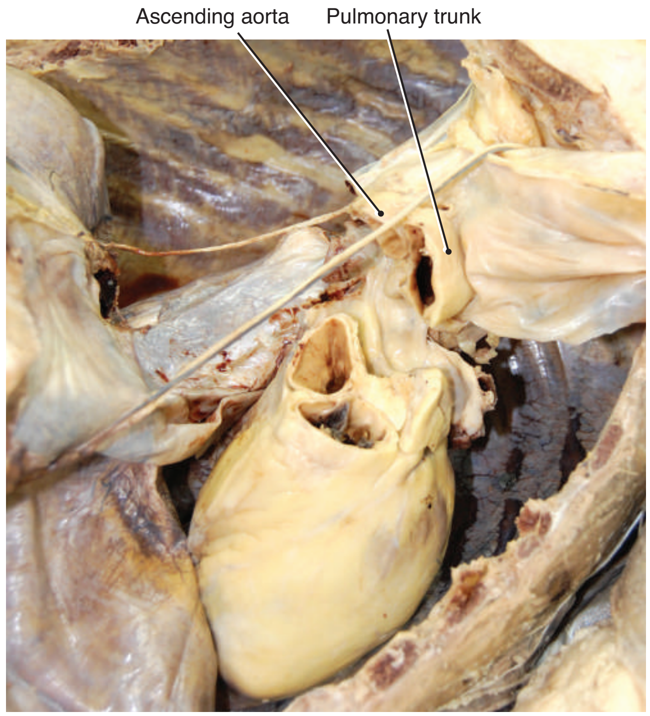

Ascending aorta
Pulmonary trunk

Fig. 5.53 External view of heart with transected great vessels.

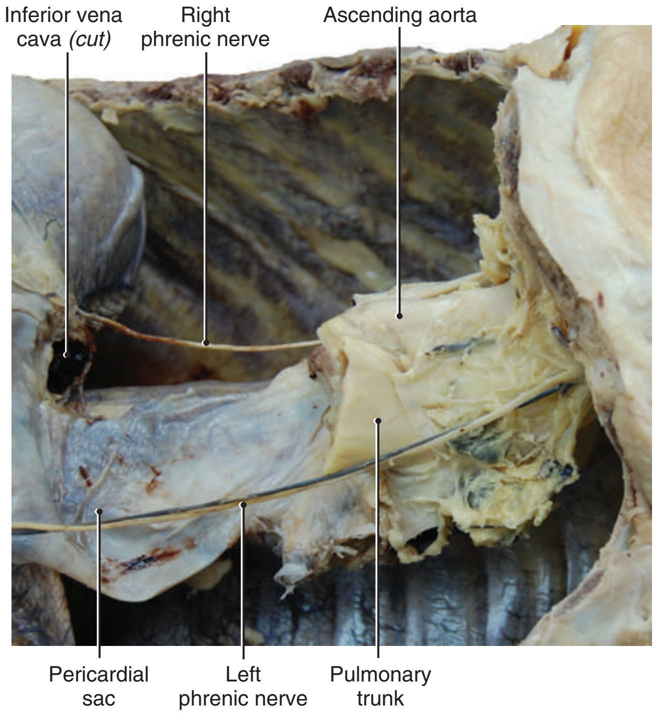
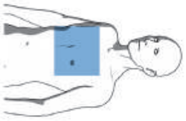

Inferior vena cava *(cut)*
Right phrenic nerve
Ascending aorta
Pericardial sac
Left phrenic nerve
Pulmonary trunk

Fig. 5.54 Bilateral lung removal, with the anterior part of the pericardial sac and heart removed.



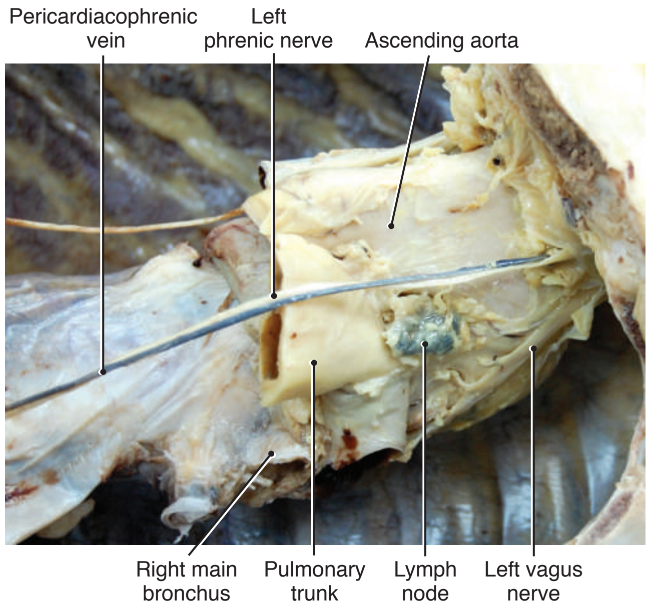
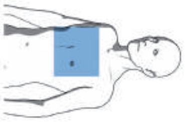

Pericardiacophrenic vein
Left phrenic nerve
Ascending aorta
Right main bronchus
Pulmonary trunk
Lymph node
Left vagus nerve

Fig. 5.55 A closer view of Fig. 5.60 shows the left vagus nerve and a regional lymph node.



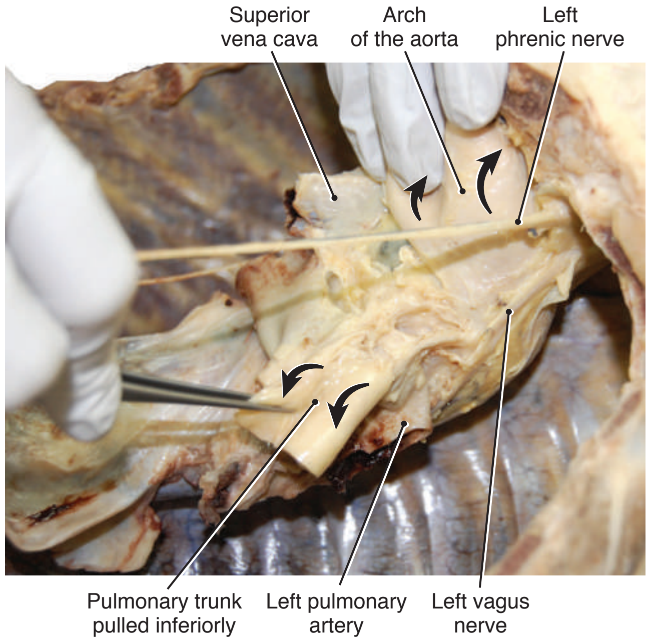
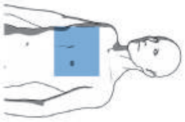

Superior vena cava
Arch of the aorta
Left phrenic nerve
Pulmonary trunk pulled inferiorly
Left pulmonary artery
Left vagus nerve

Fig. 5.56 With the pulmonary trunk displaced inferiorly, note the relationship of the phrenic and vagus nerves to the hilum of the lung. The phrenic nerve travels anterior and the vagus nerve posterior to the hilum of the lung.



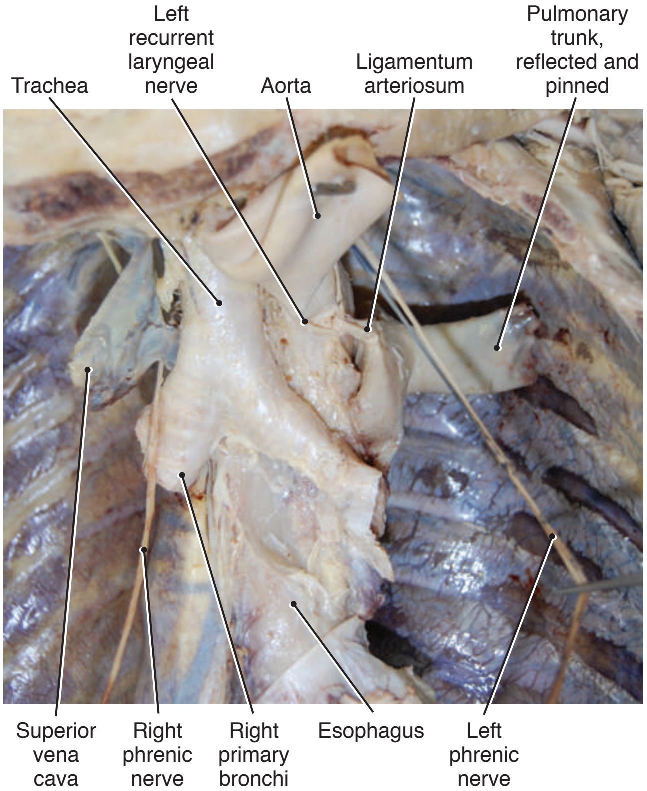
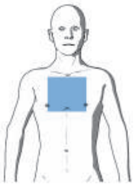

Trachea
Left recurrent laryngeal nerve
Aorta
Ligamentum arteriosum
Pulmonary trunk, reflected and pinned
Superior vena cava
Right phrenic nerve
Right primary bronchi
Esophagus
Left phrenic nerve

Fig. 5.57 Anterior view of mediastinal structures, including the aorta, trachea, and esophagus.



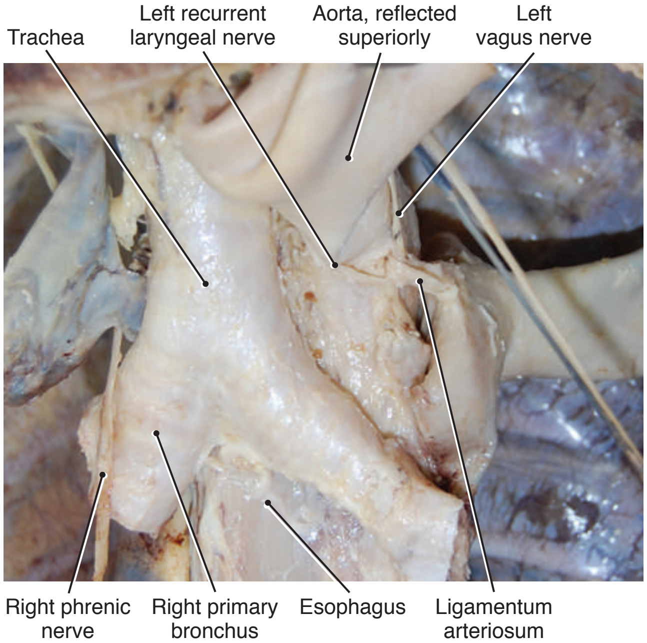
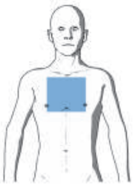

Trachea
Left recurrent laryngeal nerve
Aorta, reflected superiorly
Left vagus nerve
Right phrenic nerve
Right primary bronchus
Esophagus
Ligamentum arteriosum

Fig. 5.58 Deep mediastinal structures include right and left bronchus and vagus, phrenic, and recurrent laryngeal nerves.



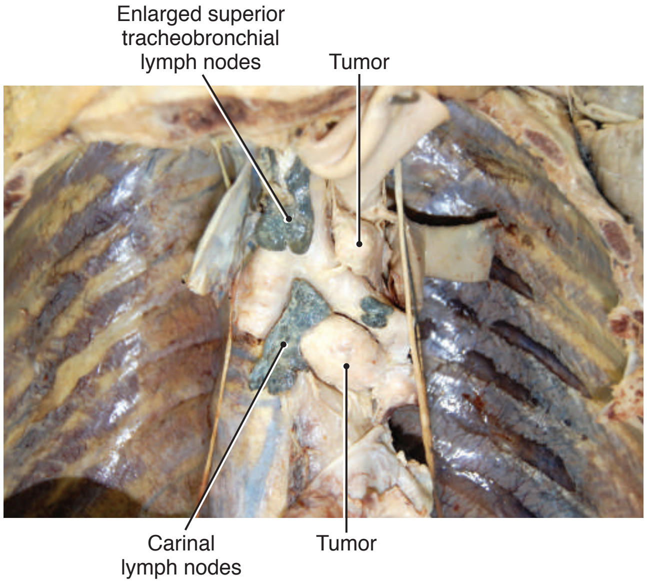
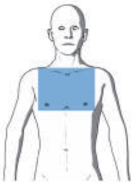

Enlarged superior tracheobronchial lymph nodes
Tumor
Carinal lymph nodes
Tumor

Fig. 5.59 Anterior view of mediastinal structures, revealing lymph nodes, right and left bronchus, reflected ascending aorta, and tumor intimate with left bronchus.



○ **Clean the left vagus nerve, and where the left vagus crosses the aortic arch, locate the left recurrent laryngeal nerve.**

ANATOMY **NOTE**

The left recurrent laryngeal nerve passes under the ligamentum arteriosum and courses upward between the trachea/esophagus and the ascending aorta in the tracheoesophageal groove. The right recurrent laryngeal nerve arises from the right vagus nerve at the level of the right subclavian artery and turns back superiorly behind this vessel, to pass upward and medially toward the larynx to enter the tracheoesophageal groove.

○ **Along the right side of the trachea (or esophagus) identify and clean the right vagus nerve. This nerve can be found by probing between the azygos vein and the lateral aspect of the trachea, at which point the right vagus nerve begins to pass posterior to the root of the right lung.**

○ **Expose the tracheal bifurcation, and identify the carinal (inferior tracheobronchial) lymph nodes. A nerve plexus anterior to the carina can be seen by cutting into the trachea at its bifurcation. The nerves represent the deep cardiac plexus formed by sympathetic and vagal fibers.**

DISSECTION **TIP**

Dissect the tracheobronchial lymph nodes; these nodes often are enlarged from malignant disease (Fig. 5.59).

- Remove the pericardium over the esophagus. With forceps, lift the esophagus and remove the pleura from over the esophagus and the vertebral column (Figs. 5.60 and 5.61).
- After removal of the pleura, dissect the fatty layer present over the vertebral bodies. Dissect between the esophagus and the vertebral bodies to identify the thoracic duct (Fig. 5.62), which often looks similar to adipose tissue.
- Clean and preserve the thoracic duct (Fig. 5.63).
- With forceps, lift the pleura, and with the aid of scissors, separate the pleura from the underlying tissues over the ribs (Figs. 5.64 and 5.65).

DISSECTION **TIP**

To reflect the pleura, use the tip of the scissors or a probe, and scrape the tissue between the pleura and the ribs. Do not cut any tissue with the forceps; use it as a probe (see Figs. 5.64 and 5.65).

- Remove the majority of pleura from the thoracic cavity (Fig. 5.66). Trace the intercostal vein, artery, and nerve traveling in one of the posterior intercostal spaces.

DISSECTION **TIP**

Use the handle of your scissors to remove fat over the intercostal space (Fig. 5.67).

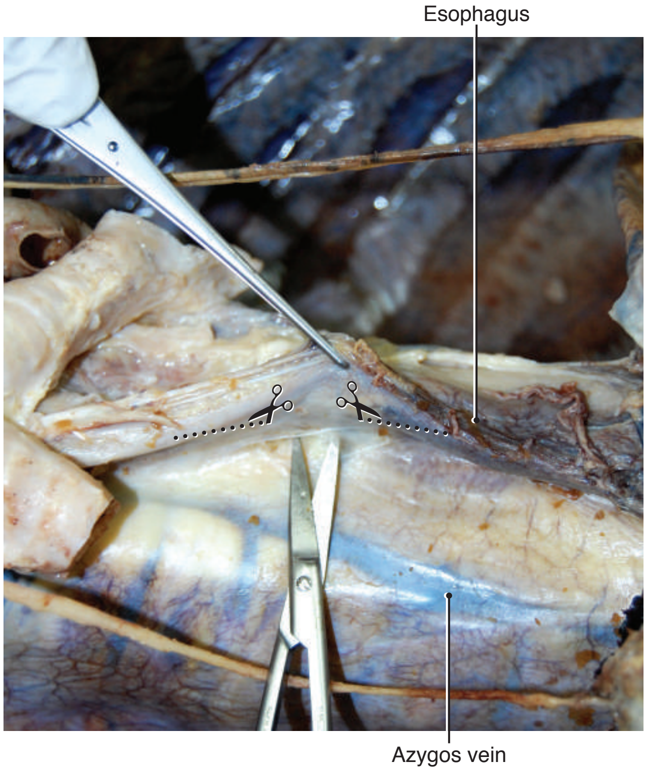
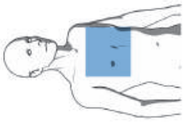


Fig. 5.61 Anterolateral view of deep posterior mediastinal structures with tension on mediastinal pleura.



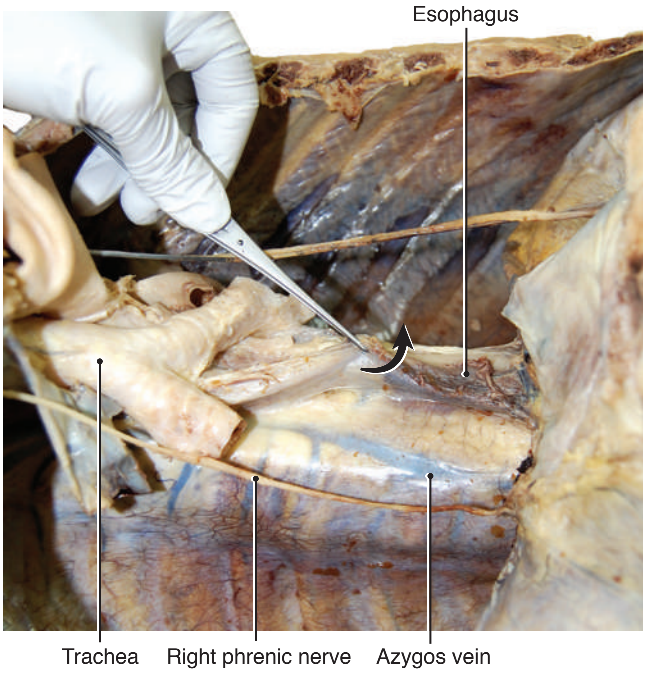
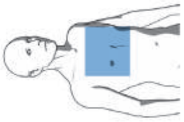


Fig. 5.60 Anterolateral view of the posterior mediastinum. Note that the esophagus is being retracted laterally.



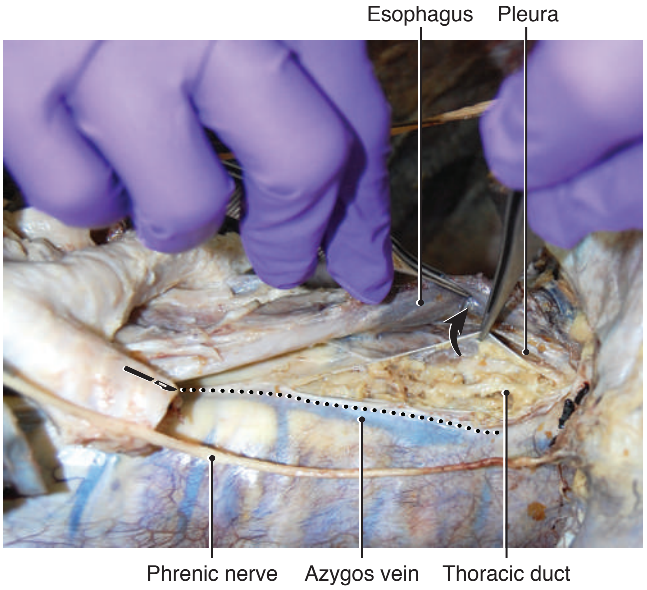
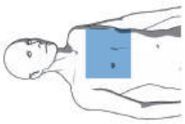


Fig. 5.62 Anterolateral view of deep posterior mediastinal structures, highlighting the thoracic duct, esophagus, and azygos vein.



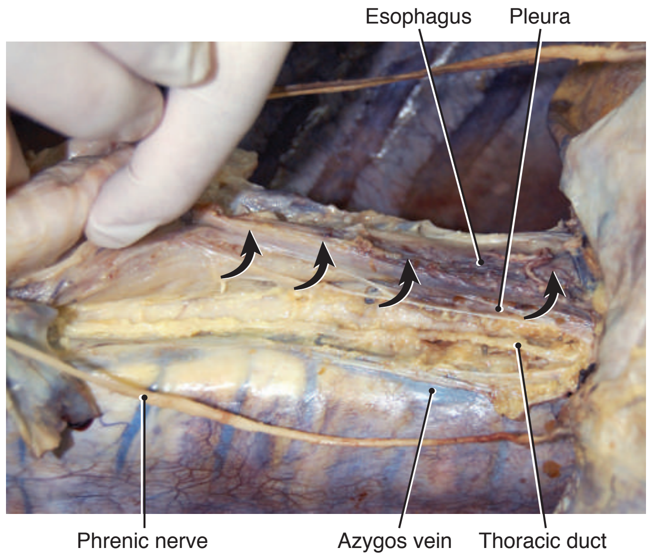
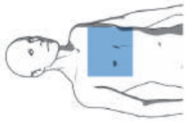

Esophagus
Pleura
Phrenic nerve
Azygos vein
Thoracic duct

Fig. 5.63 Anterolateral view of deep posterior mediastinal structures, demonstrating the thoracic duct, esophagus, and azygos vein.



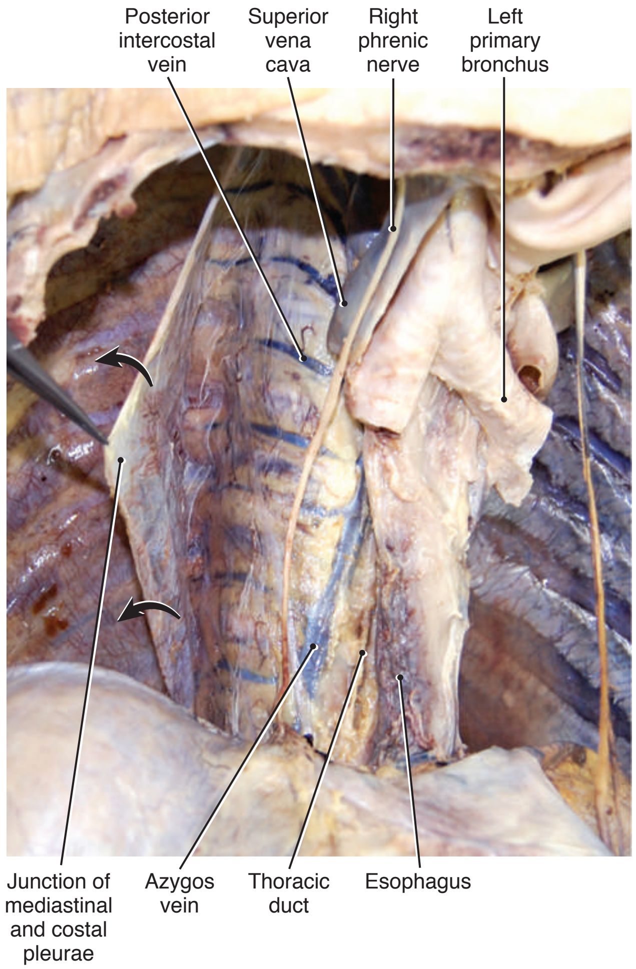
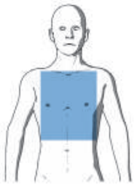

Posterior intercostal vein
Superior vena cava
Right phrenic nerve
Left primary bronchus
Junction of mediastinal and costal pleurae
Azygos vein
Thoracic duct
Esophagus

Fig. 5.65 Anterior view of posterior chest wall structures, revealing posterior intercostal vein, azygos vein, superior vena cava, and interface between mediastinal and costal pleurae.



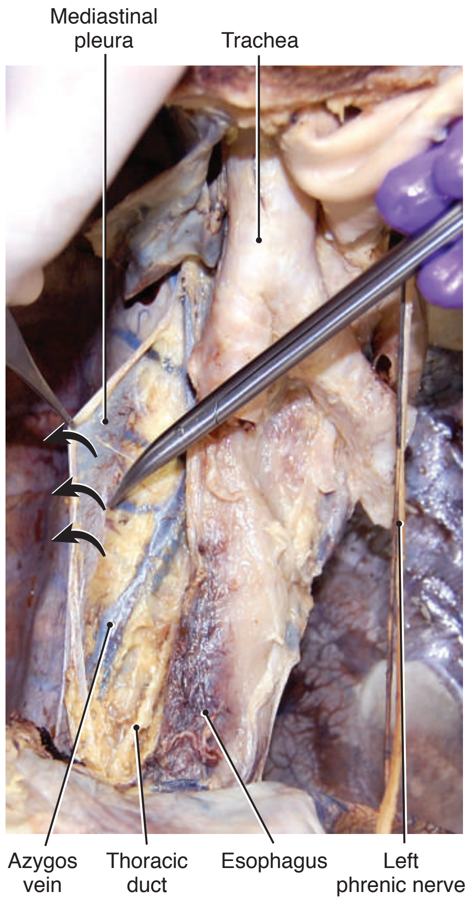
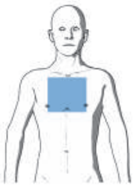

Mediastinal pleura
Trachea
Azygos vein
Thoracic duct
Esophagus
Left phrenic nerve

Fig. 5.64 Anterior view of deep mediastinal structures, revealing azygos vein, thoracic duct, and esophagus.



- Trace and identify the sympathetic trunk that runs along the junction between the vertebral bodies and ribs and appears as a white line. Near the midportion of the thoracic vertebral column, identify a bundle of nerve fibers originating from the sympathetic chain and running obliquely toward the midline (Fig. 5.68). This is the *greater splanchnic nerve,* formed primarily from fibers of the sympathetic trunk.
- Clean the sympathetic trunk and identify the greater (T5-T9), lesser (T10-T11), and least (T12) splanchnic nerves (Fig. 5.69, Plate 5.2).

DISSECTION **TIP**

The origin of the greater, lesser, and least splanchnic nerves is subject to variation. Also, the lesser and least splanchnic nerves are often difficult to see in the thorax before removal of the liver on the right, and because of an immobile descending thoracic aorta on the left.

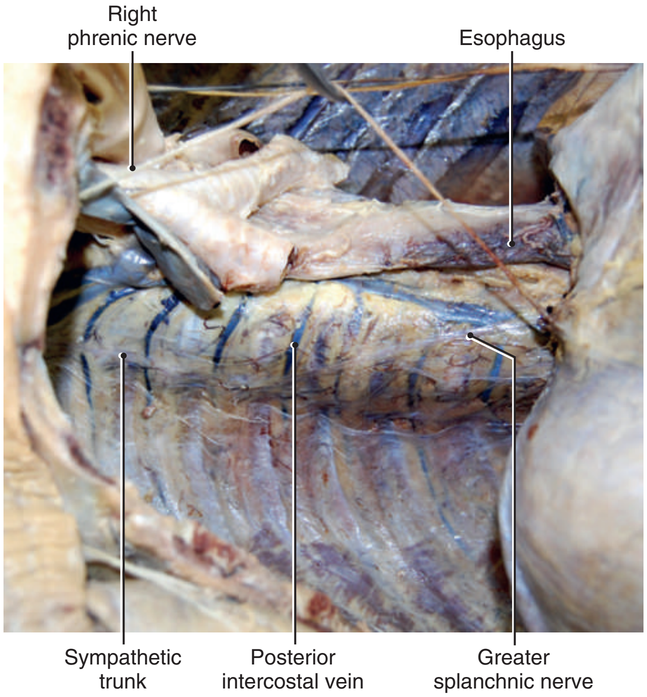
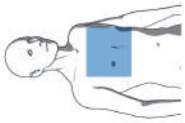

Right phrenic nerve
Esophagus
Sympathetic trunk
Posterior intercostal vein
Greater splanchnic nerve

Fig. 5.66 Right lateral view of posterior chest wall, revealing sympathetic trunk, greater splanchnic nerves, and posterior intercostal vein.



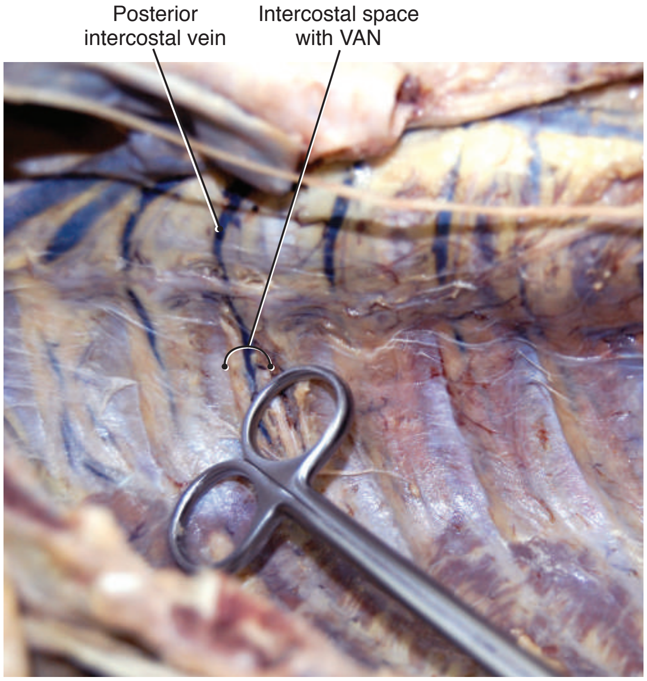
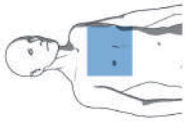

Posterior intercostal vein
Intercostal space with VAN

Fig. 5.67 Right lateral view of posterior chest wall, revealing neurovascular structures of the intercostal space at T4. *VAN,* Vein, artery, nerve.



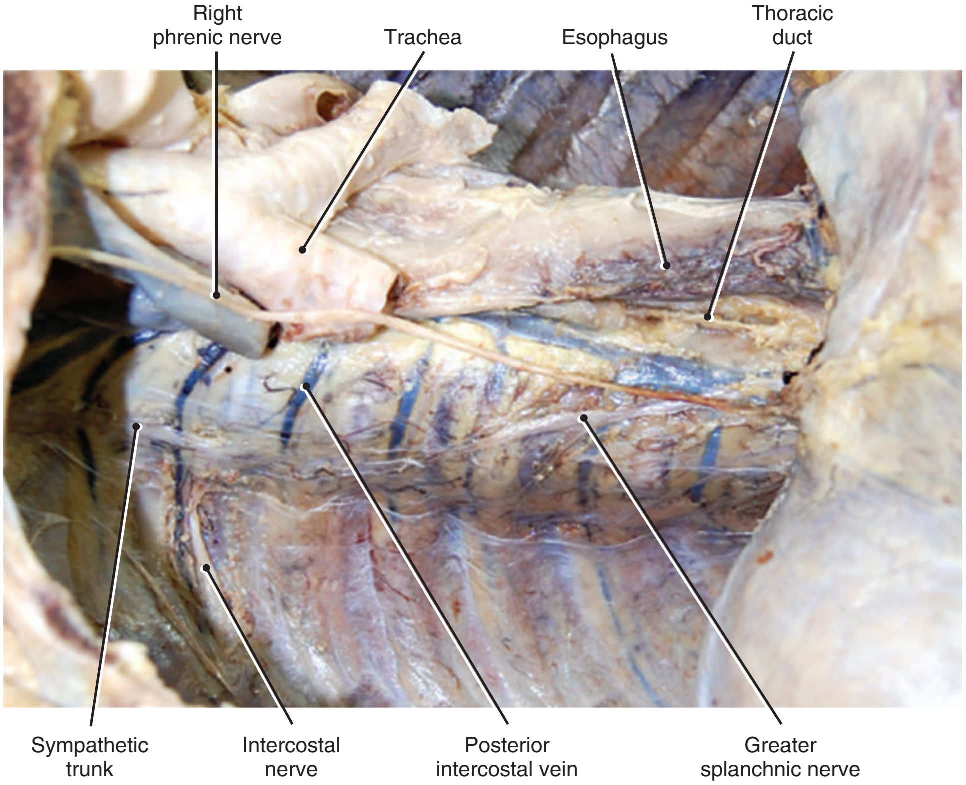
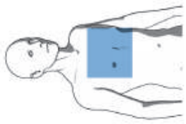

Right phrenic nerve
Trachea
Esophagus
Thoracic duct
Sympathetic trunk
Intercostal nerve
Posterior intercostal vein
Greater splanchnic nerve

Fig. 5.68 Right lateral view of posterior chest wall, demonstrating the sympathetic trunk, greater splanchnic nerve, and intercostal nerve.



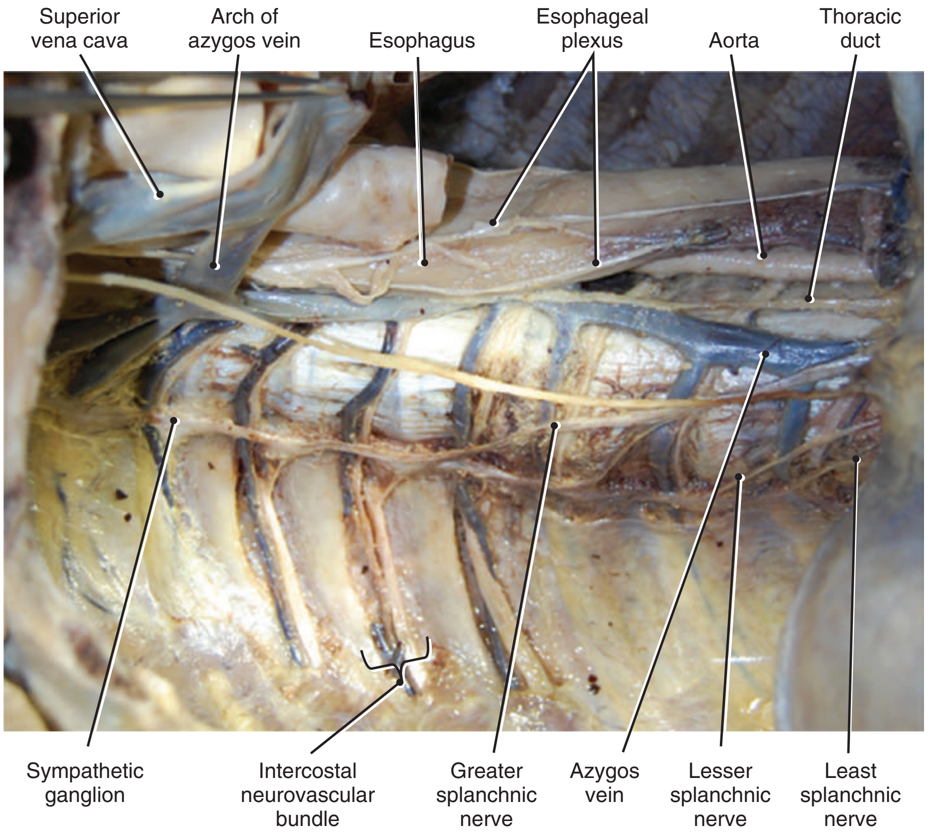
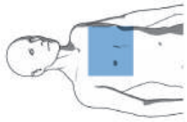

Superior vena cava
Arch of azygos vein
Esophagus
Esophageal plexus
Aorta
Thoracic duct
Sympathetic ganglion
Intercostal neurovascular bundle
Greater splanchnic nerve
Azygos vein
Lesser splanchnic nerve
Least splanchnic nerve

Fig. 5.69 Right lateral view of posterior chest wall, highlighting sympathetic trunk, sympathetic ganglion, and greater and lesser splanchnic nerves.



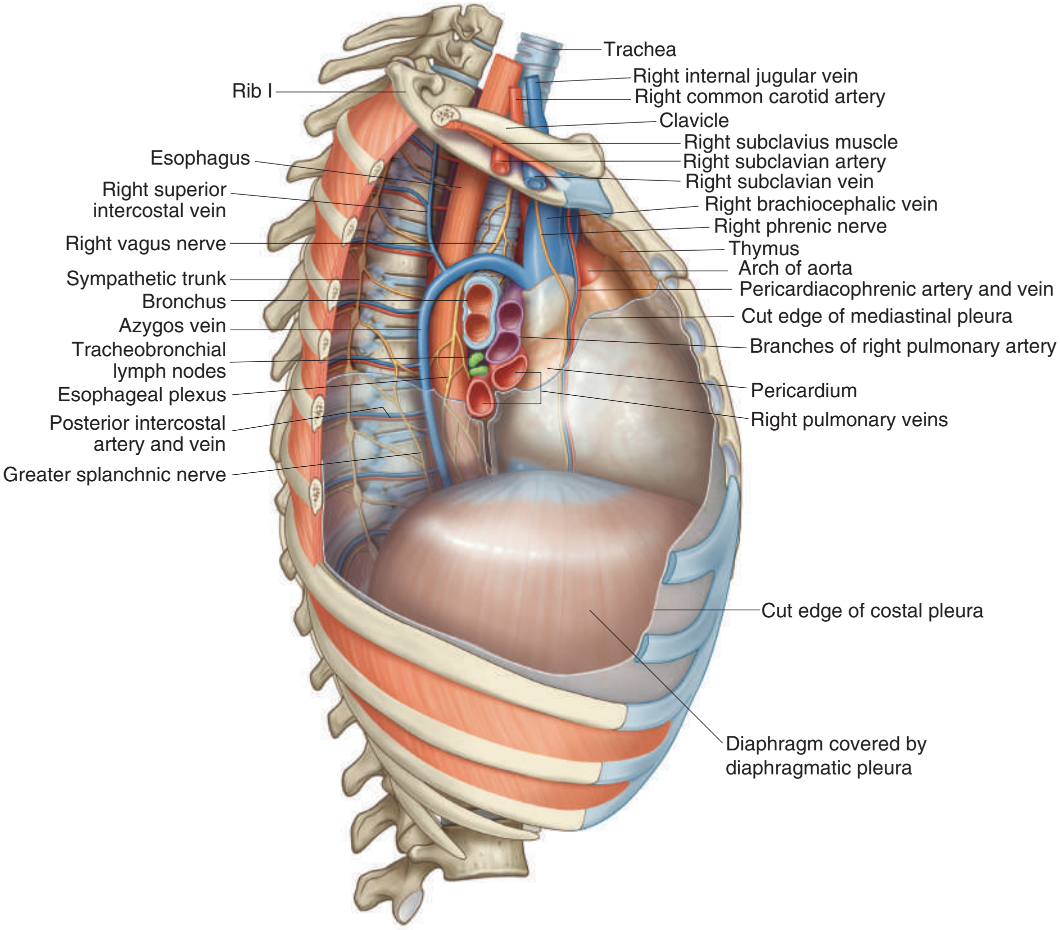

Trachea
Rib I
Right internal jugular vein
Right common carotid artery
Clavicle
Right subclavius muscle
Esophagus
Right subclavian artery
Right subclavian vein
Right superior intercostal vein
Right brachiocephalic vein
Right phrenic nerve
Right vagus nerve
Thymus
Arch of aorta
Sympathetic trunk
Pericardiacophrenic artery and vein
Bronchus
Cut edge of mediastinal pleura
Azygos vein
Branches of right pulmonary artery
Tracheobronchial lymph nodes
Pericardium
Esophageal plexus
Right pulmonary veins
Posterior intercostal artery and vein
Greater splanchnic nerve
Cut edge of costal pleura
Diaphragm covered by diaphragmatic pleura

Plate 5.2 Right side of hemithorax and mediastinum.

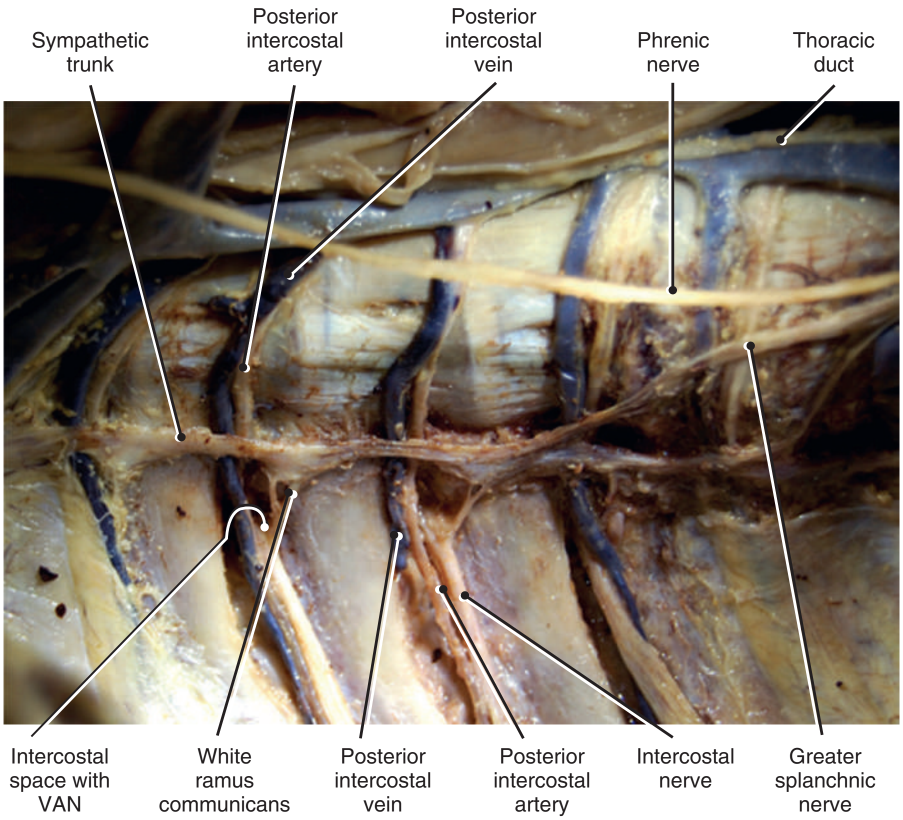
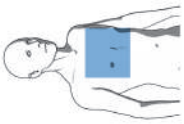

Sympathetic trunk
Posterior intercostal artery
Posterior intercostal vein
Phrenic nerve
Thoracic duct
Intercostal space with VAN
White ramus communicans
Posterior intercostal vein
Posterior intercostal artery
Intercostal nerve
Greater splanchnic nerve

Fig. 5.70 Right lateral view of posterior chest wall with sympathetic trunk, white ramus communicans, and intercostal nerve. *VAN,* Vein, artery, nerve.



- After cleaning out the sympathetic trunk and thoracic splanchnic nerves, dissect and clean the communicating rami connecting the sympathetic trunk with the intercostal nerves. Identify the white and gray rami communicantes (Fig. 5.70).
- Trace the left and right vagus nerves as they descend behind the right and left primary bronchi to form the esophageal plexus on the anterior surface of the esophagus (Fig. 5.71).
- Trace the superior vena cava and the veins draining into it. To the right of the superior vena cava, find the azygos vein draining into it (see Fig. 5.71). Identify the right posterior intercostal veins anterior and superior to the vertebral bodies.
- On the left side of the thorax, identify the hemiazygos vein with the lowest three or four left posterior intercostal venous tributaries. Lift the esophagus at the midline, and note the accessory hemiazygos vein crossing the midline to join the azygos vein (Fig. 5.72).

DISSECTION **TIP**

The arch of the aorta and the descending thoracic aorta can be displaced or atherosclerotic, making the dissection of the left posterior thorax difficult. Often the greater, lesser, and least splanchnic nerves, as well as the hemiazygos and accessory hemiazygos veins, are hidden behind the aorta.

- Lift the midportion the thoracic aorta, and note the origin of the posterior intercostal arteries. Identify the esophageal and bronchial arteries arising from the anterior aspect of the aorta (Figs. 5.73 and 5.74).

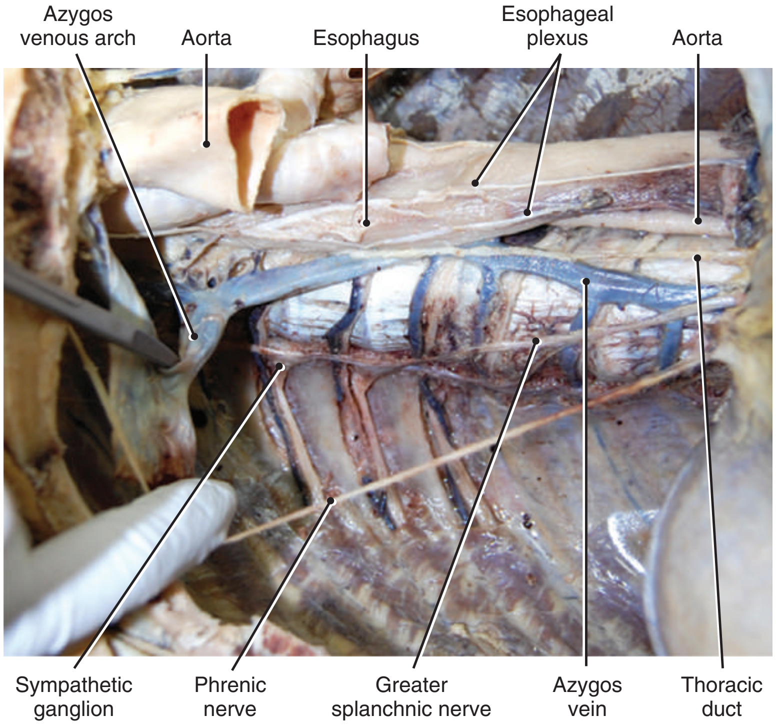
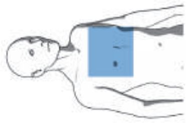

Azygos venous arch
Aorta
Esophagus
Esophageal plexus
Aorta
Sympathetic ganglion
Phrenic nerve
Greater splanchnic nerve
Azygos vein
Thoracic duct

Fig. 5.71 Right lateral view of posterior chest wall, revealing azygos vein, sympathetic trunk, ganglion, and splanchnic nerve.



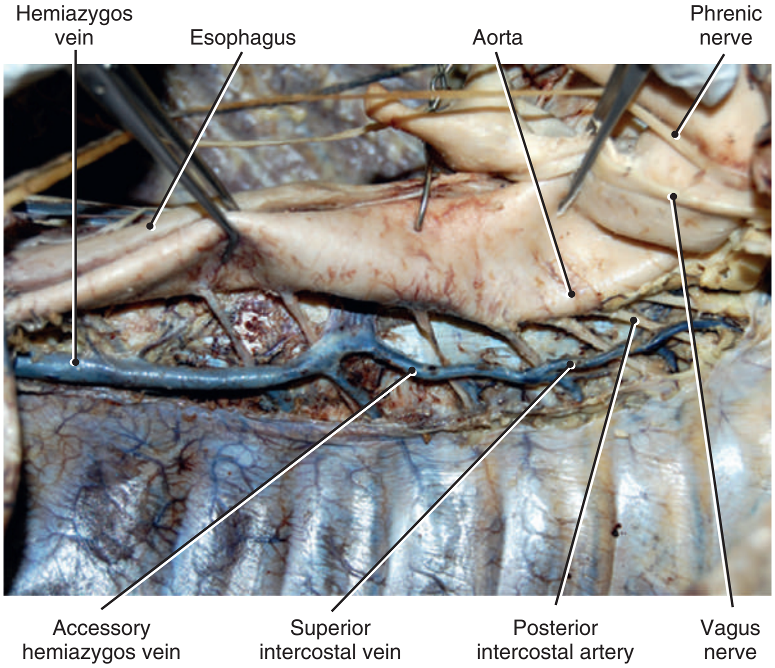
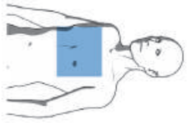

Hemiazygos vein
Esophagus
Aorta
Phrenic nerve
Accessory hemiazygos vein
Superior intercostal vein
Posterior intercostal artery
Vagus nerve

Fig. 5.72 Left lateral view of posterior thoracic wall, revealing accessory azygos and accessory hemiazygos veins.



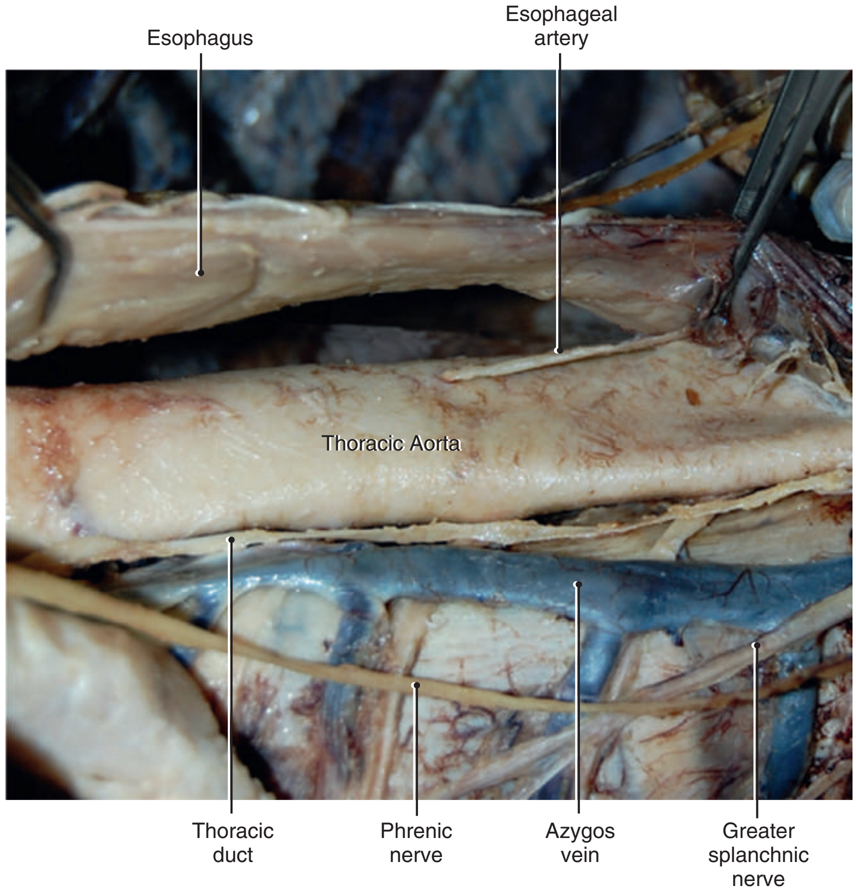
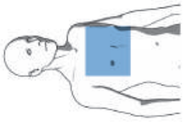

Esophagus
Esophageal artery
Thoracic Aorta
Thoracic duct
Phrenic nerve
Azygos vein
Greater splanchnic nerve

Fig. 5.73 Right lateral view of posterior chest wall, demonstrating the esophagus, esophageal artery, aorta, thoracic duct, and azygos vein.



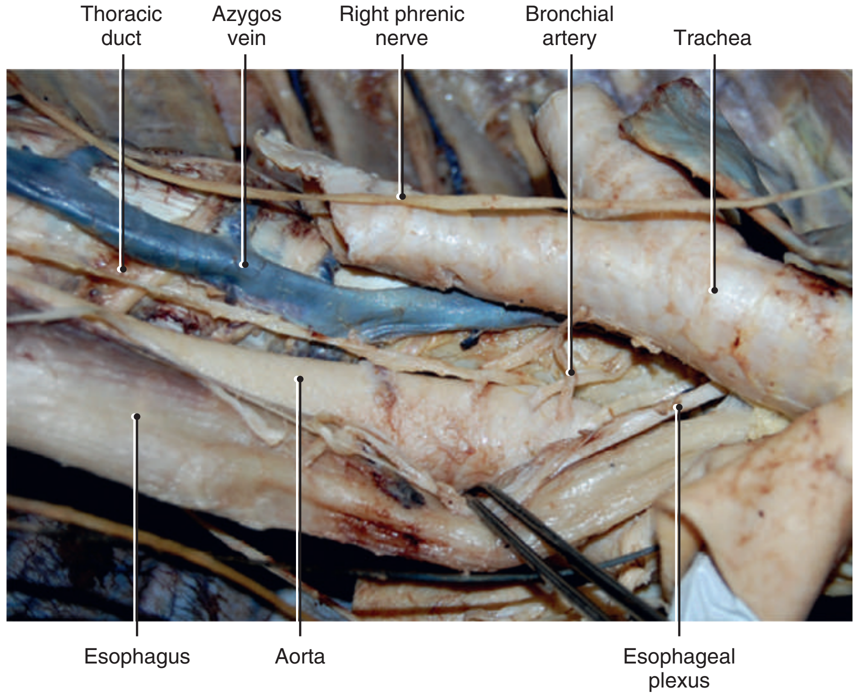
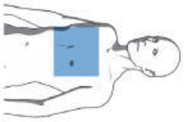

Thoracic duct
Azygos vein
Right phrenic nerve
Bronchial artery
Trachea
Esophagus
Aorta
Esophageal plexus

Fig. 5.74 Left lateral view of posterior mediastinum with the esophagus and esophageal plexus reflected, demonstrating the aorta, thoracic duct, and azygos vein.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Anterior intercostal
- ☐ Intercostobrachial (T2)
- ☐ Lateral intercostal T3-T7
- ☐ Intercostal
- ☐ Sympathetic trunk
- ☐ Sympathetic ganglia
- ☐ Greater splanchnic
- ☐ Lesser splanchnic
- ☐ Least splanchnic
- ☐ Gray and white rami communicantes
- ☐ Stellate ganglion
- ☐ Phrenic
- ☐ Vagus
- ☐ Right recurrent laryngeal
- ☐ Left recurrent laryngeal
- ☐ Esophageal plexus
- ☐ Cardiac plexus

ARTERIES

- ☐ Aorta
- ☐ Subclavian
- ☐ Internal thoracic
- ☐ Superior epigastric
- ☐ Musculophrenic
- ☐ Pericardiacophrenic
- ☐ Pulmonary
- ☐ Bronchial
- ☐ Esophageal
- ☐ Anterior intercostal
- ☐ Posterior intercostal

VEINS

- ☐ Superior vena cava
- ☐ Inferior vena cava
- ☐ Subclavian
- ☐ Internal thoracic
- ☐ Superior epigastric
- ☐ Brachiocephalic
- ☐ Anterior intercostal
- ☐ Posterior intercostal
- ☐ Azygos
- ☐ Accessory hemiazygos
- ☐ Hemiazygos

MUSCLES

- ☐ External intercostal
- ☐ Internal intercostal
- ☐ Innermost intercostal
- ☐ Transversus thoracis
- ☐ Subcostals
- ☐ Diaphragm

LYMPHATICS

- ☐ Thoracic duct

LIGAMENT

- ☐ Ligamentum arteriosum

GLAND

- ☐ Thymus

ORGAN TISSUES

- ☐ Lung
  - ☐ Hilum
  - ☐ Lingula
  - ☐ Oblique fissure
- ☐ Parietal pleura
- ☐ Visceral pleura
- ☐ Pulmonary ligament
- ☐ Lobes of right and left lungs
- ☐ Primary bronchi
- ☐ Secondary bronchi
- ☐ Tertiary bronchi
- ☐ Apex of heart
- ☐ Base of heart
- ☐ Esophagus

BONES

- ☐ Sternum
- ☐ Ribs
- ☐ Bodies of thoracic vertebrae with intervertebral discs

CHAPTER 6 HEART

ATLAS REFERENCES

Netter: 216–230
McMinn: 185–191
Gray's Atlas: 92–107

BEFORE YOU BEGIN

Inspection

Inspect the heart externally and identify the following:

- Right atrium
- Right auricle
- Superior vena cava (SVC)
- Inferior vena cava (IVC)
- Subpulmonary infundibulum or conus
- Pulmonary artery
- Ascending aorta
- Left atrium
- Pulmonary veins
- Left auricle (Figs. 6.1 to 6.4)

Identify the *sulcus terminalis*, a shallow groove on the surface of the right atrium, which extends between the right side of the orifice of the SVC and that of the IVC.

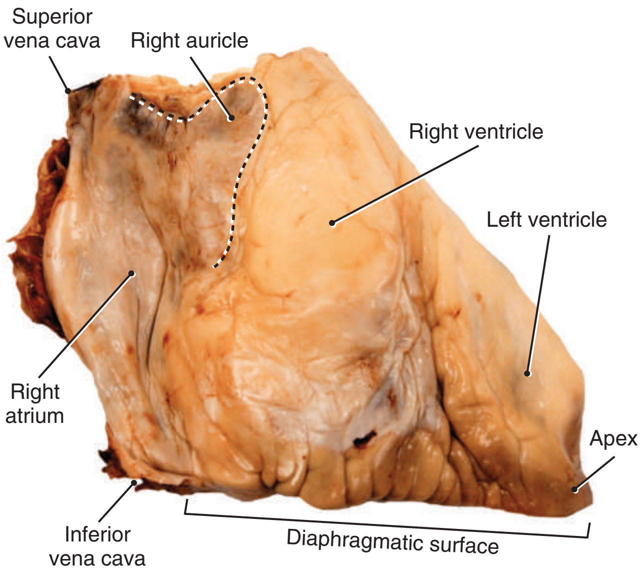
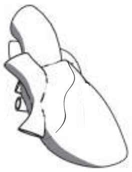

Superior
vena cava
Right auricle
Right ventricle
Left ventricle
Right
atrium
Apex
Inferior
vena cava
Diaphragmatic surface

Fig. 6.1 Anterior view of external surfaces of the heart; *dotted outline*, right auricle.



DISSECTION **TIP**

The dissection typically begins with the exposure and identification of the coronary arteries. Note the apex of the left ventricle and the *acute* (right) (see Fig. 6.1) and *obtuse* (left) (see Fig. 6.4) margins of the heart.

CORONARY ARTERIES

- **To remove the epicardium (visceral pericardium) and the fat covering the right coronary artery, identify the right auricle and retract it laterally.**
- **Palpate the space between the right auricle and the atrioventricular (AV, coronary) groove or sulcus, and expose the proximal part of the right coronary artery (Fig. 6.5).**

DISSECTION **TIP**

Most of the coronary arteries in adults can be felt with palpation because of their increased hardening from atherosclerotic changes of aging.

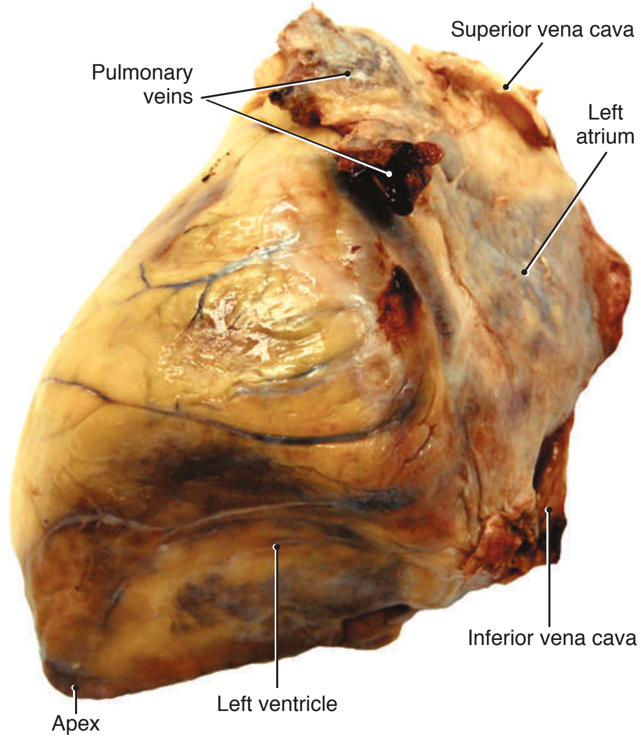
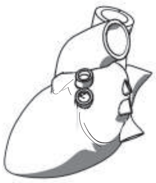

Superior vena cava
Pulmonary
veins
Left
atrium
Inferior vena cava
Left ventricle
Apex

Fig. 6.2 Topographic view of left atrium and ventricle.



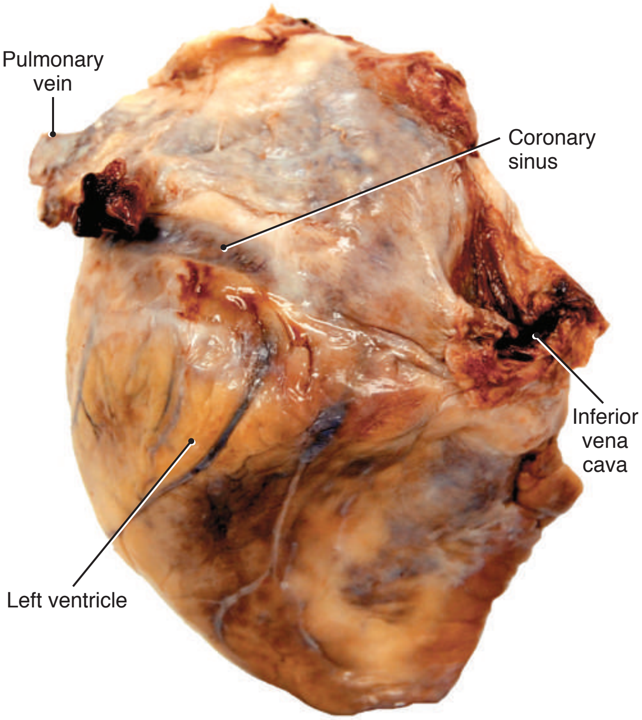

Pulmonary vein
Coronary sinus
Inferior vena cava
Left ventricle

Fig. 6.3 Topographic view of the posterior heart.

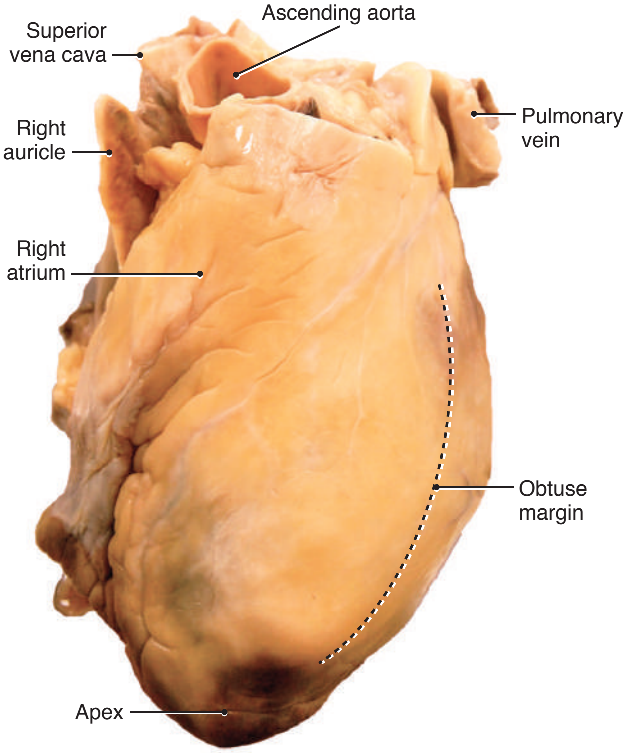

Superior vena cava
Ascending aorta
Right auricle
Pulmonary vein
Right atrium
Obtuse margin
Apex

Fig. 6.4 Base, margin, and apex of topographic heart; *dotted line,* obtuse margin.

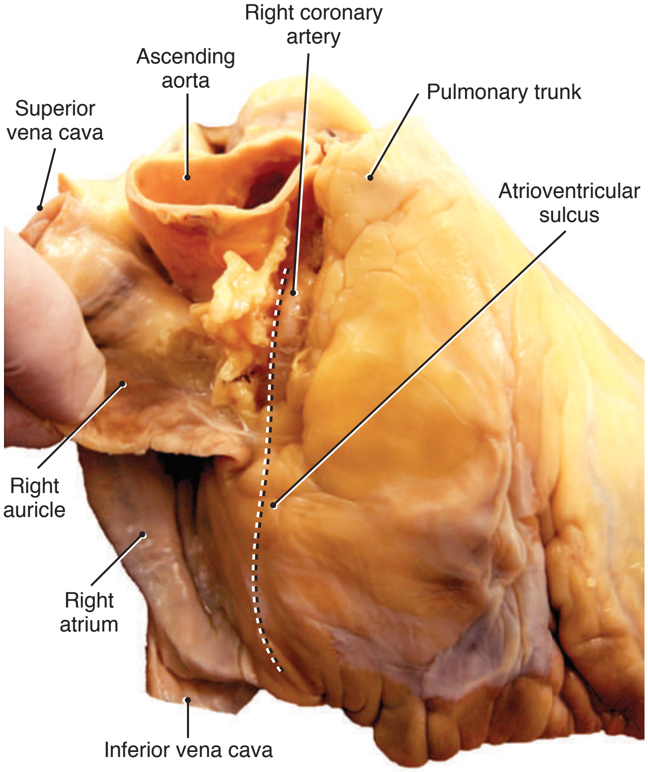
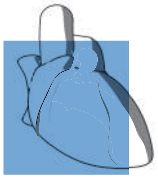

Right coronary artery
Ascending aorta
Superior vena cava
Pulmonary trunk
Atrioventricular sulcus
Right auricle
Right atrium
Inferior vena cava

Fig. 6.5 Topographic view of base of heart structures; *dotted line,* tracing of right coronary artery.



ANATOMY **NOTE**

The terms *atrium* and *auricle* are not synonymous. The auricles are appendages of the atria.

- **Expose the superficial portion of the *right coronary artery* (RCA) by cleaning away the epicardium and fat covering the vessel (Fig. 6.6).**
- **Trace the RCA toward the right side of the diaphragmatic surface of the heart, taking care to protect its branches.**
- **As the artery passes near the edge of the right auricle, it usually gives off the artery of the sinu-atrial node (Fig. 6.7).**

ANATOMY **NOTE**

The sinu-atrial (SA) nodal artery arises from the proximal portion of the RCA in 65% of cases, traveling upward to the right atrium at the junction of the SVC and the right auricle, where it enters the sinu-atrial node. In the remaining cases, the SA nodal artery arises from the proximal portion of the left coronary artery.

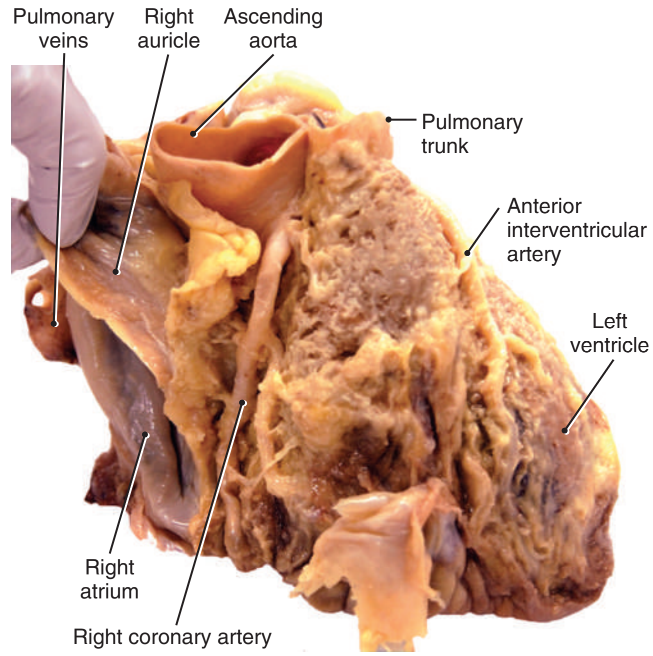
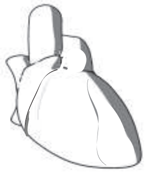

Pulmonary veins
Right auricle
Ascending aorta
Pulmonary trunk
Anterior interventricular artery
Left ventricle
Right atrium
Right coronary artery

Fig. 6.6 Dissection of right coronary artery from its origin.



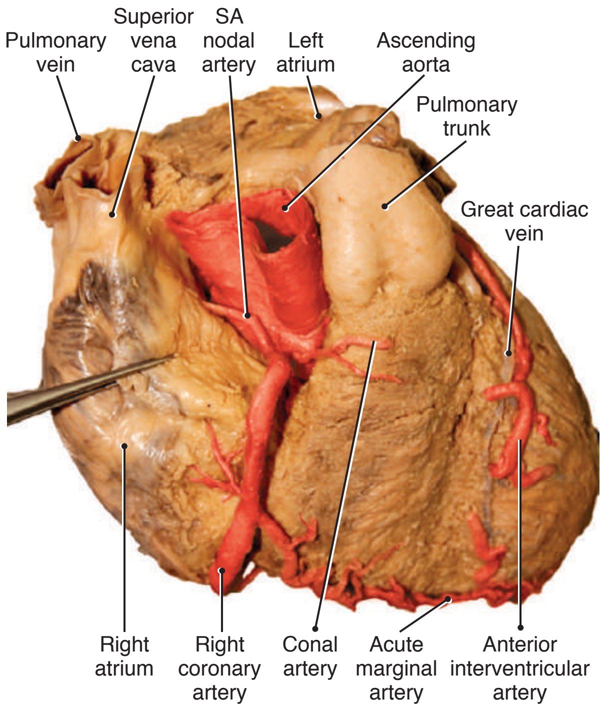

Pulmonary vein
Superior vena cava
SA nodal artery
Left atrium
Ascending aorta
Pulmonary trunk
Great cardiac vein
Right atrium
Right coronary artery
Conal artery
Acute marginal artery
Anterior interventricular artery

Fig. 6.7 Dissection of right coronary artery from its origin. *SA*, Sinu-atrial.

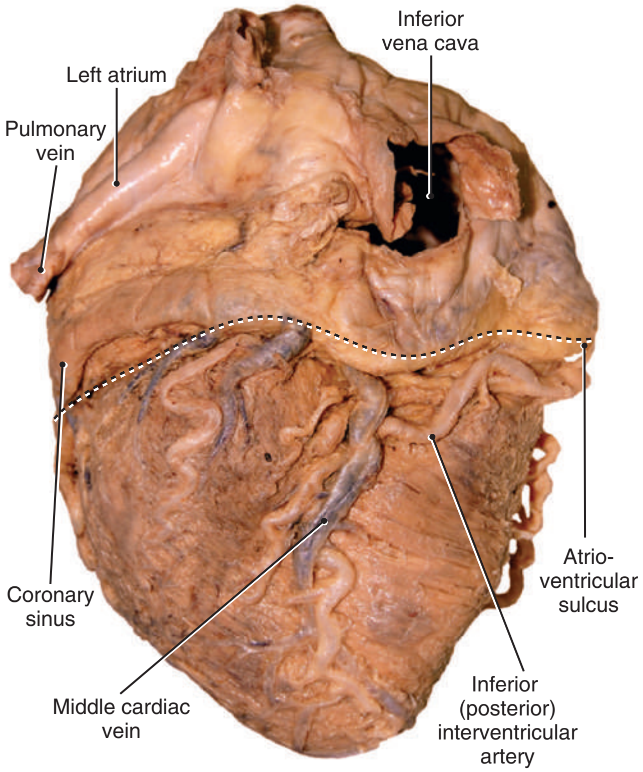
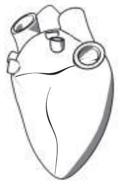

Inferior vena cava
Left atrium
Pulmonary vein
Coronary sinus
Atrio-ventricular sulcus
Middle cardiac vein
Inferior (posterior) interventricular artery

Fig. 6.8 Posterior view of heart with the inferior (posterior) interventricular artery and middle cardiac vein exposed.



- **The second branch of the RCA is the artery of the conus, or *conal artery.* The conal artery arises from the proximal part of the RCA and passes to the left, around the right ventricle, at the level of the subpulmonary infundibulum (see Fig. 6.7). Close to the diaphragmatic surface of the heart, the RCA typically gives rise to the right marginal artery, which supplies the inferior border of the right ventricle.**
- **The RCA continues posteriorly in the AV (atrioventricular) groove and in most cases descends and terminates in the inferior (posterior) interventricular groove as the inferior (posterior) interventricular (descending) artery (Fig. 6.8).**

ANATOMY **NOTE**

This artery supplies the inferior third of the interventricular septum and a portion of the inferior wall of the left ventricle.

- **Before it becomes the inferior (posterior) interventricular artery, the RCA will give off the artery of the atrioventricular (AV) node.**

ANATOMY **NOTE**

In 80% of specimens, the AV nodal artery arises from the RCA near the inferior (posterior) interventricular groove as it crosses the "crux" of the heart (Fig. 6.9). The crux of the heart is the center point of the anatomic base where the atria and ventricles are most closely approximated posteriorly.

DISSECTION **TIP**

To identify the artery to the AV node, carefully lift the left atrium at the inferior (posterior) AV groove, and clean away the fat (see Fig. 6.9B).

- To remove the epicardium (visceral pericardium) and the fat covering the left coronary artery, identify the left auricle and retract it laterally (Figs. 6.10 and 6.11).
- Palpate the space between the left auricle, the AV (coronary) sulcus, and expose the proximal part of the left coronary artery (Figs. 6.12 and 6.13).
- The left coronary artery is typically very small (a few centimeters in length) and divides into the anterior interventricular coronary artery (left anterior descending) and left circumflex artery.
- Palpate the anterior interventricular groove, and feel for the anterior interventricular artery. Use the separation technique to expose the anterior interventricular artery. This vessel gives off relatively large diagonal branches to the anterior surface of the left ventricle (Fig. 6.14).

ANATOMY **NOTE**

An often-encountered variation is the presence of myocardial bridges covering the left anterior interventricular artery, which penetrates the myocardium for a few centimeters and emerges distally as an epicardial artery (see Fig. 6.14).

- Deeply penetrating septal branches arise from the deep surface of the anterior interventricular artery

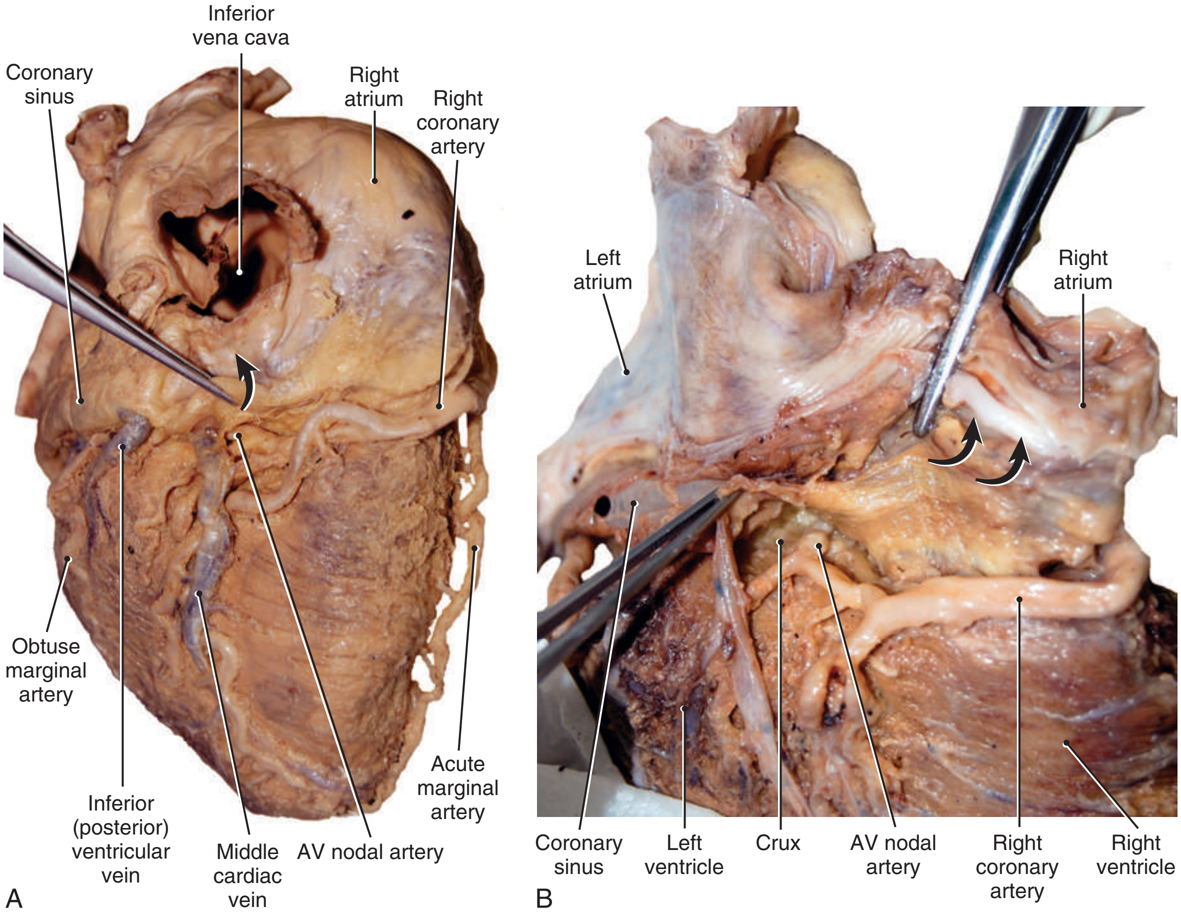
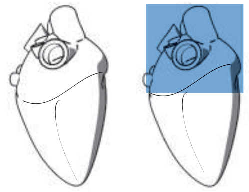

Inferior vena cava
Coronary sinus
Right atrium
Right coronary artery
Obtuse marginal artery
Acute marginal artery
Inferior (posterior) ventricular vein
Middle cardiac vein
AV nodal artery
A
Left atrium
Right atrium
Coronary sinus
Left ventricle
Crux
AV nodal artery
Right coronary artery
Right ventricle
B

Fig. 6.9 A, Posterior view of heart with inferior (posterior) interventricular artery and artery to the atrioventricular (AV) node exposed. B, Left atrium pulled back to reveal AV nodal artery within crux of heart.



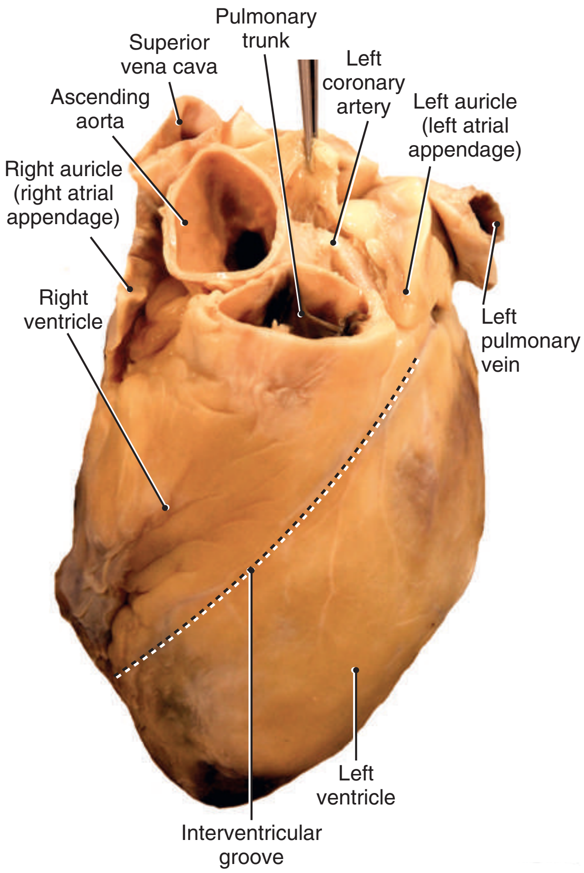
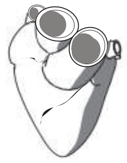

Pulmonary trunk
Superior vena cava
Left coronary artery
Ascending aorta
Left auricle (left atrial appendage)
Right auricle (right atrial appendage)
Right ventricle
Left pulmonary vein
Left ventricle
Interventricular groove

Fig. 6.10 Vertical tilt of heart revealing its base and apex.



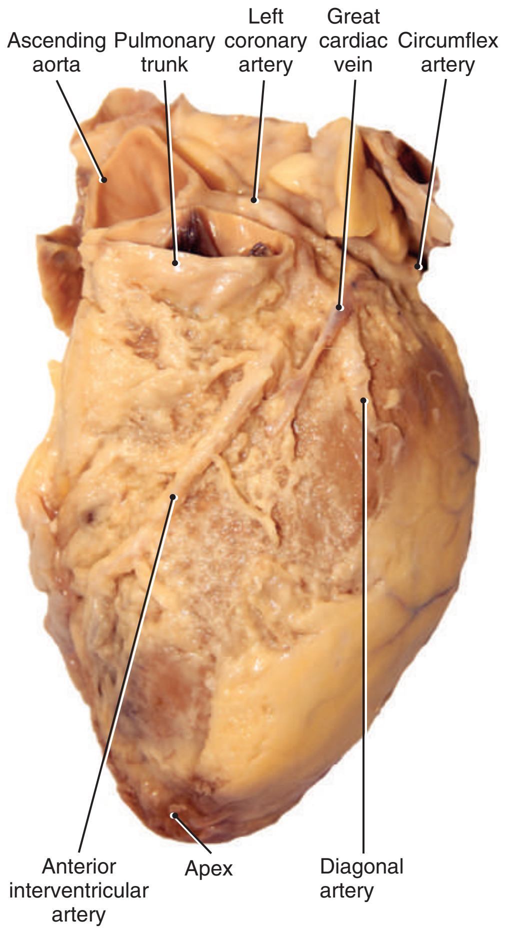
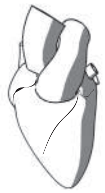

Ascending aorta
Pulmonary trunk
Left coronary artery
Great cardiac vein
Circumflex artery
Anterior interventricular artery
Apex
Diagonal artery

Fig. 6.12 Epicardial fat is removed from the surface of the left ventricle and the anterior interventricular artery is exposed.



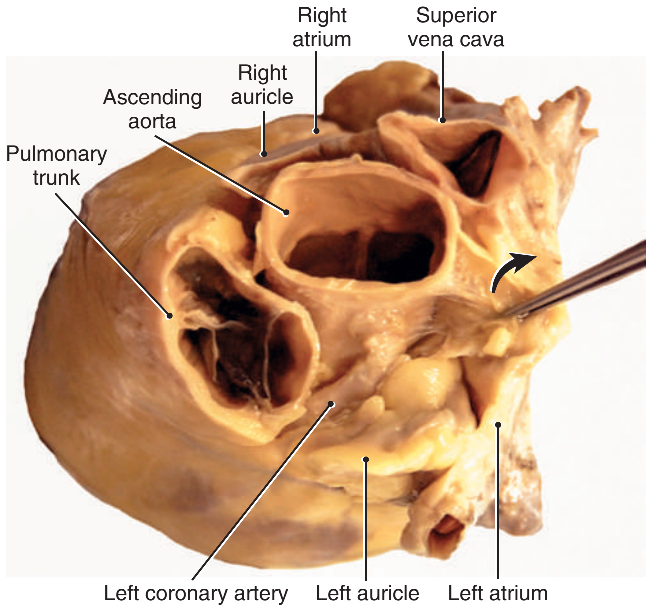
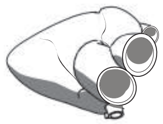

Right atrium
Superior vena cava
Right auricle
Ascending aorta
Pulmonary trunk
Left coronary artery
Left auricle
Left atrium

Fig. 6.11 Superior view of the great vessels. To the left of the great vessels, fat is reflected and the origin of the left coronary artery is exposed.



and enter the muscular interventricular septum (Figs. 6.15 and 6.16) at the level of the subpulmonary infundibulum to supply the proximal parts of the left and right bundle branches.

- **The circumflex coronary artery runs in the left AV groove toward the left border and around to the base of the heart. This vessel typically gives off the left marginal artery crossing the left border of the heart, supplying the left ventricular free wall (Fig. 6.17).**

ANATOMY **NOTE**

Numerous variations exist in the pattern of distribution of the right and left coronary arteries. Among the most common of the variations is the source of the inferior (posterior) interventricular coronary artery. In the majority of cases, the RCA provides the source for this artery. In about 15% of cases, however, the left circumflex artery gives off this branch.

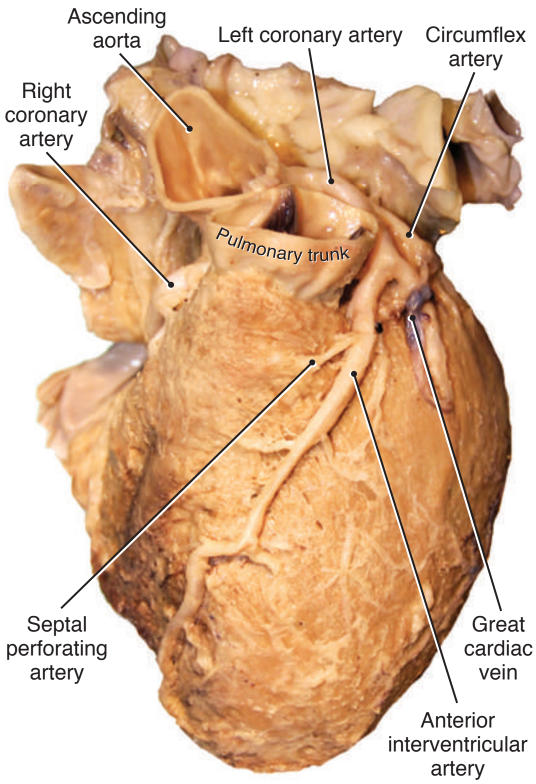

Ascending aorta
Left coronary artery
Circumflex artery
Right coronary artery
Pulmonary trunk
Septal perforating artery
Great cardiac vein
Anterior interventricular artery

Fig. 6.13 Epicardial fat removed from left ventricle with the anterior interventricular artery exposed.

DISSECTION **TIP**

At many times during this dissection, it is possible to identify hearts that have undergone coronary artery bypass graft (CABG) procedures (Figs. 6.18 and 6.19).

- Try to expose the graft vessel and identify to which vessel it is connected.
- On the posterior surface of the heart at the AV sulcus between the IVC and the left atrium, identify the *coronary sinus,* a small confluence of veins approximately 2 cm long.

ANATOMY **NOTE**

The coronary sinus receives the great cardiac vein, the middle cardiac vein, and occasionally, the small cardiac vein and the oblique vein of the left atrium.

- Identify the **great cardiac vein**, which lies in the anterior interventricular groove, accompanying the left anterior interventricular artery.
- The **middle cardiac vein** lies in the inferior (posterior) interventricular groove and accompanies the inferior (posterior) interventricular artery.

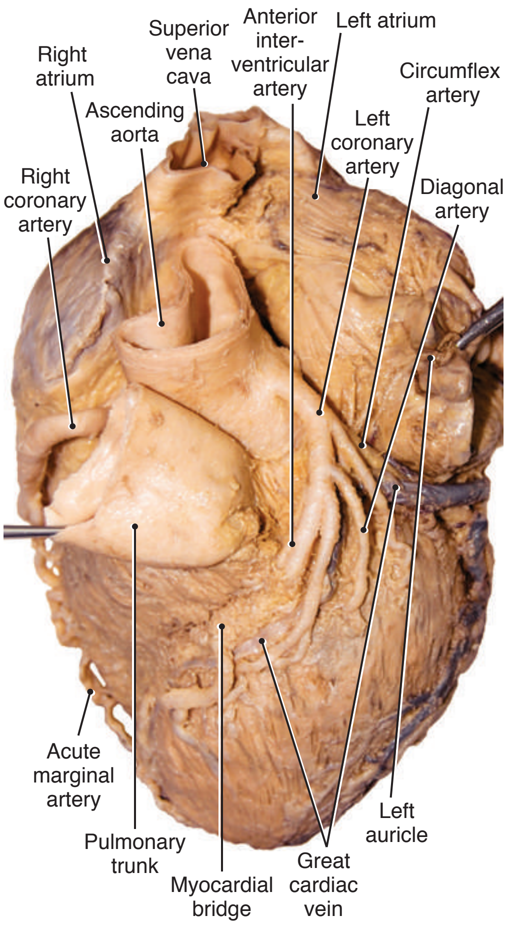

Right atrium
Superior vena cava
Anterior inter-ventricular artery
Left atrium
Circumflex artery
Ascending aorta
Left coronary artery
Right coronary artery
Diagonal artery
Acute marginal artery
Pulmonary trunk
Myocardial bridge
Great cardiac vein
Left auricle

Fig. 6.14 Removing epicardial fat from the left ventricle and exposing the anterior interventricular artery to reveal diagonal branches and a myocardial bridge.

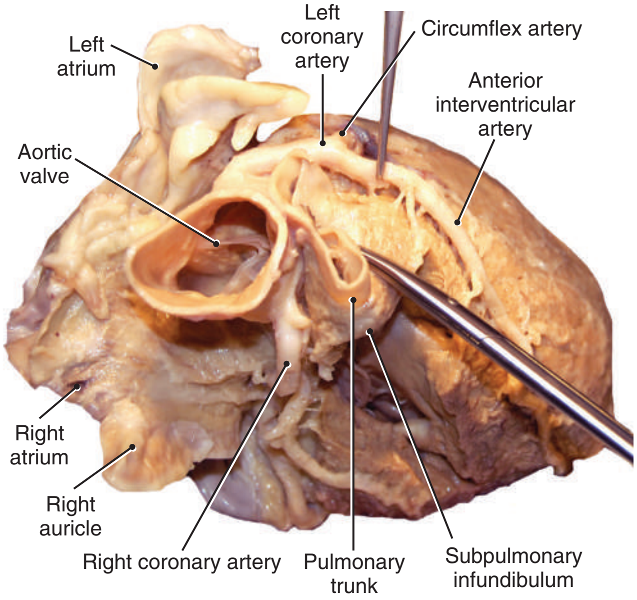

Left atrium
Left coronary artery
Circumflex artery
Anterior interventricular artery
Aortic valve
Right atrium
Right auricle
Right coronary artery
Pulmonary trunk
Subpulmonary infundibulum

Fig. 6.15 Anterior interventricular artery is retracted, and septal perforating branches are exposed.

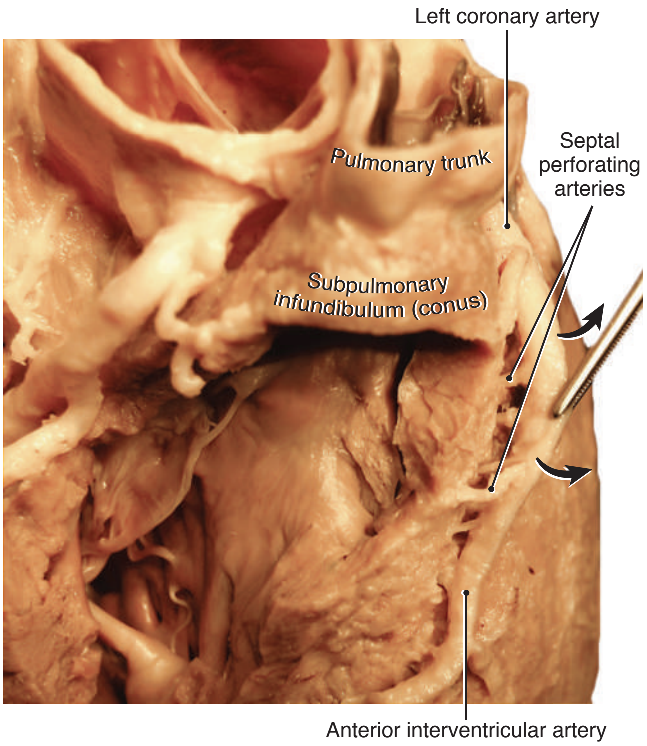

Left coronary artery
Pulmonary trunk
Septal perforating arteries
Subpulmonary infundibulum (conus)
Anterior interventricular artery

Fig. 6.16 Left coronary artery with septal and anterior interventricular branches.

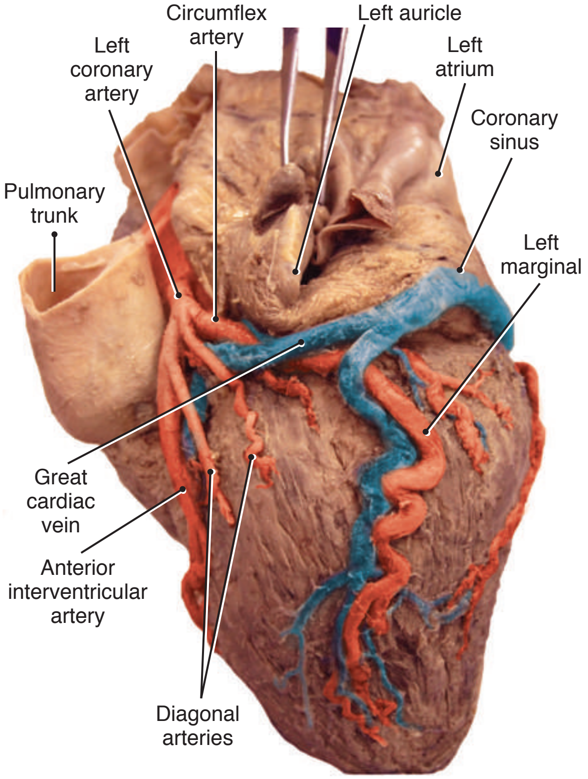

Circumflex artery
Left auricle
Left coronary artery
Left atrium
Coronary sinus
Pulmonary trunk
Left marginal
Great cardiac vein
Anterior interventricular artery
Diagonal arteries

Fig. 6.17 Lateral view with vertical tilt revealing left coronary artery, circumflex and marginal branches.

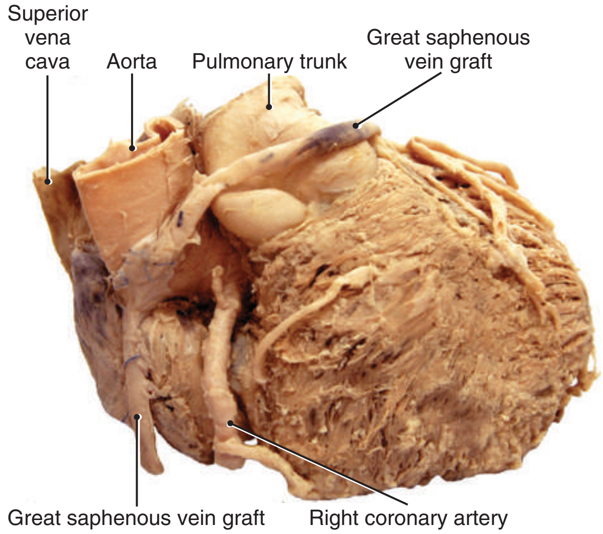

Superior vena cava
Aorta
Pulmonary trunk
Great saphenous vein graft
Great saphenous vein graft
Right coronary artery

Fig. 6.18 Anterior view of the heart demonstrating a great saphenous vein graft.

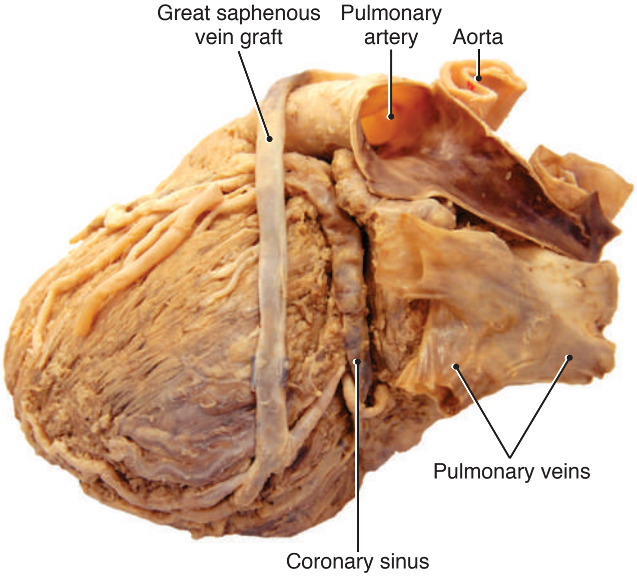
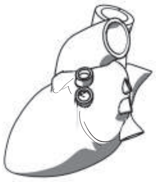

Great saphenous vein graft
Pulmonary artery
Aorta
Pulmonary veins
Coronary sinus

Fig. 6.19 Posterior view revealing the great saphenous vein graft.



- The **small cardiac vein** lies in the AV groove next to the opening of the coronary sinus. This vein usually joins the right marginal vein or separately opens into the right atrium.

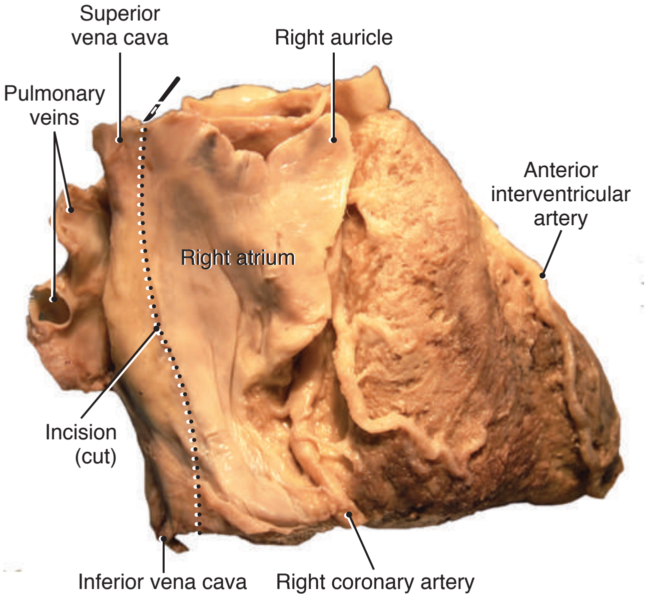
DISSECTION **TIP**

The cardiac veins have very thin walls and are often damaged during dissection.

DISSECTION OF HEART

Right Atrium

- Incise the right atrium laterally, making a vertical incision from the inferior vena cava to the superior vena cava (Fig. 6.20), and avoid cutting the IVC valve.
- With forceps, reflect the flap made by the lateral incision in the right atrium, and observe the muscular ridge within the chamber, the *crista terminalis* (Fig. 6.21 and Plate 6.1).
- Note the **pectinate muscles** arising from the crista terminalis and fanning out through the wall of the right auricle.
- Observe the smooth roof of the right atrium between the orifices of the two venae cavae, the *sinus venarum*.
- Within the right atrium, note the valve of the IVC (eustachian valve), medial to the opening of the IVC. Note the valve (thebesian valve) and ostium of the coronary sinus (coronary os).
- Note also the venae cordis minimae (thebesian veins), which are small openings in the internal surface of the right atrium.


Superior vena cava
Right auricle
Pulmonary veins
Anterior interventricular artery
Right atrium
Incision (cut)
Inferior vena cava
Right coronary artery

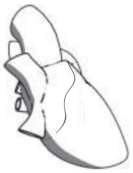


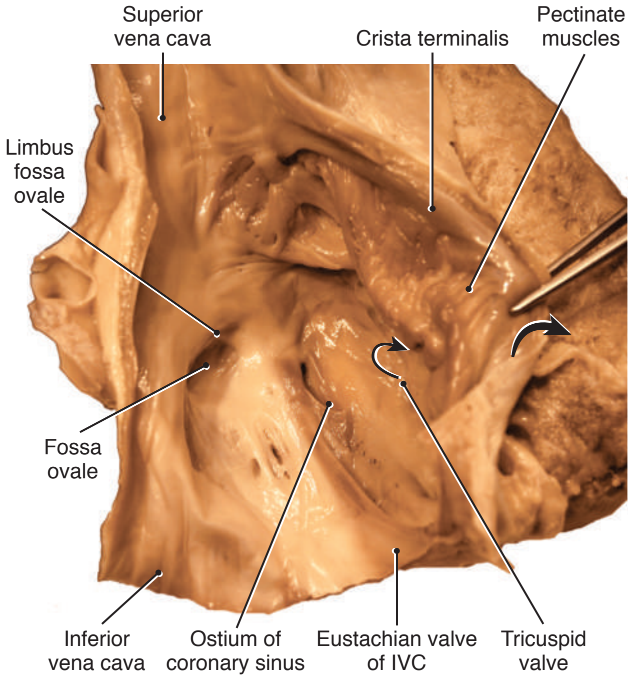
Fig. 6.20 Anterior view of the right atrium with incision landmark between the inferior and superior venae cavae.

- The interatrial septum forms the medial wall of the right atrium.
- Within the septum is a depressed region, the *fossa ovalis* (fossa ovale), bordered by a thicker rim of muscle, the superior limbus fossa ovalis (Fig. 6.22).

ANATOMY **NOTE**

The fossa ovalis marks the line of fusion between the original embryonic septum secundum with the septum primum, closing the ostium secundum. In 20% of cases, the area of fusion in the interatrial septum is incomplete, and an oblique fissure of communication between the two atria is retained. This is known as a "probe-patent foramen ovale" (Fig. 6.23).

- Turn the right atrium upward, and note the *tricuspid valve* and its three leaflets: septal, anterior, and posterior.
- The separation of the three leaflets may not be well delineated.
- Identify the membranous septum between the septal and anterior leaflets of the tricuspid valve.
- Place one finger deeply within the aorta (below the level of its valve) while palpating the base of the interatrial septum with the thumb of the same hand. The small area where the thumb and the finger are separated by the thinnest amount of tissue marks the site of the membranous septum (Figs. 6.24 and 6.25).


Superior vena cava
Crista terminalis
Pectinate muscles
Limbus fossa ovale
Fossa ovale
Inferior vena cava
Ostium of coronary sinus
Eustachian valve of IVC
Tricuspid valve

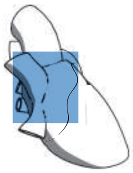


Fig. 6.21 Superior and inferior venae cavae opened with a vertical incision, revealing internal structures of the right atrium. *IVC,* Inferior vena cava.

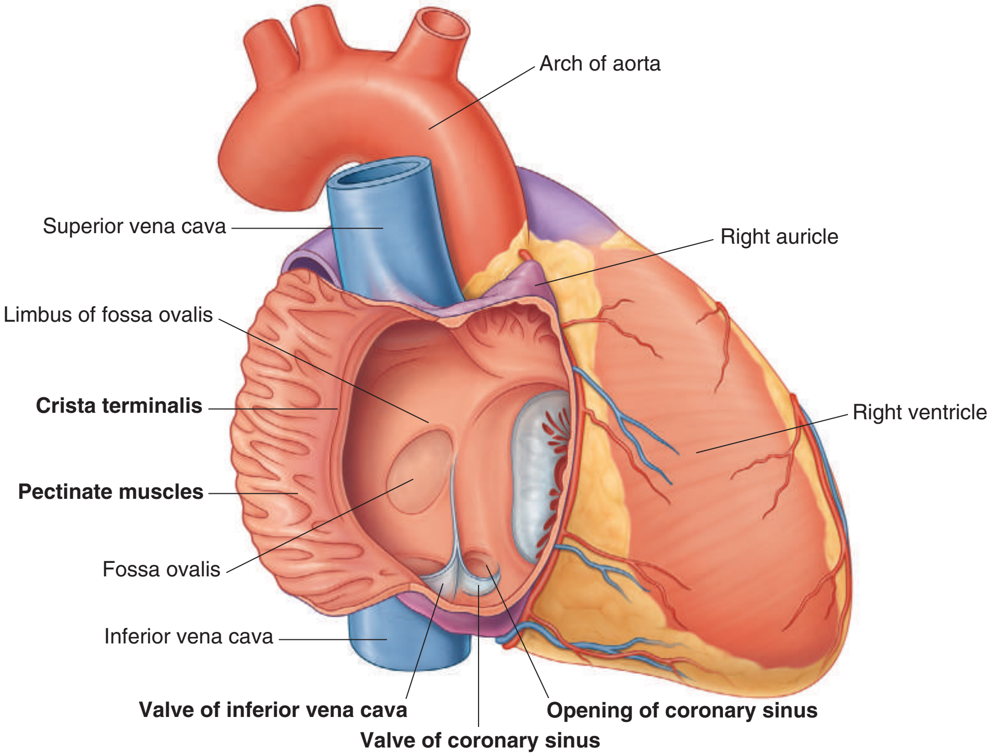

Arch of aorta
Superior vena cava
Right auricle
Limbus of fossa ovalis
Crista terminalis
Right ventricle
Pectinate muscles
Fossa ovalis
Inferior vena cava
Valve of inferior vena cava
Opening of coronary sinus
Valve of coronary sinus

Plate 6.1 A view of the structures of the right atrium.

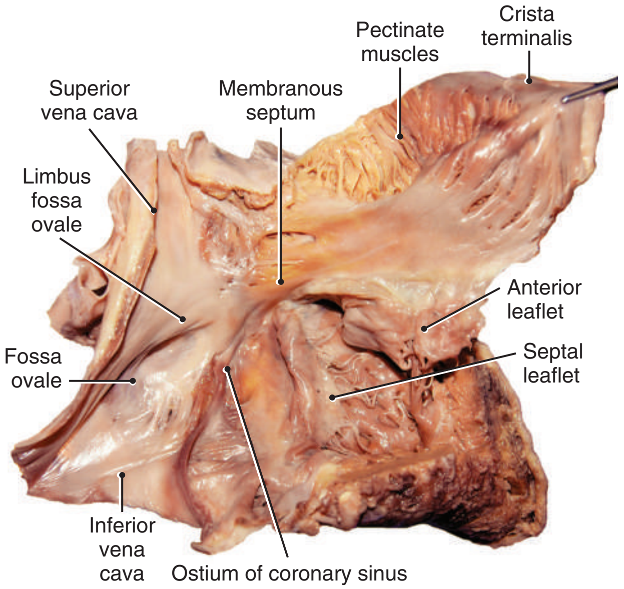
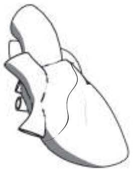

Crista terminalis
Pectinate muscles
Superior vena cava
Membranous septum
Limbus fossa ovale
Anterior leaflet
Septal leaflet
Fossa ovale
Inferior vena cava
Ostium of coronary sinus

Fig. 6.22 Internal aspect of the heart and superior vena cava.



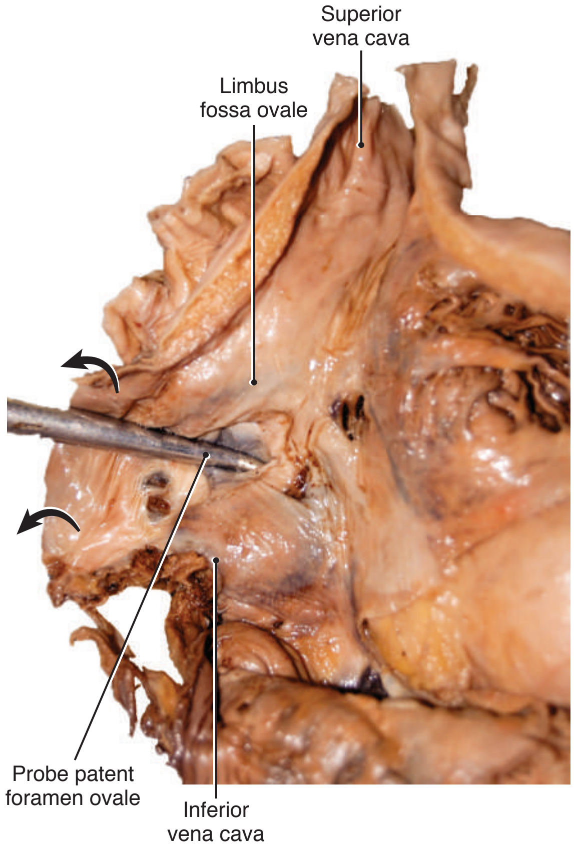
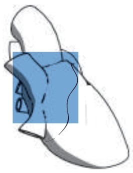

Superior vena cava
Limbus fossa ovale
Probe patent foramen ovale
Inferior vena cava

Fig. 6.23 Right atrium reflected to reveal patent foramen ovale.



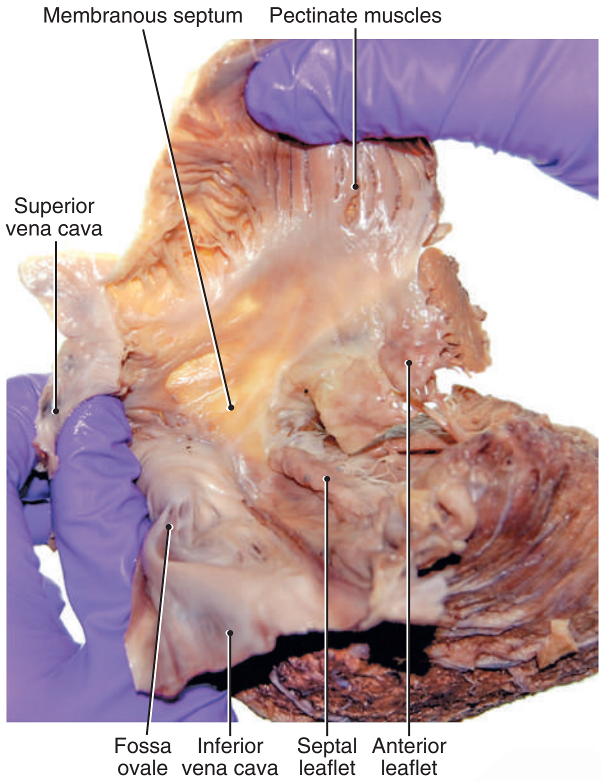
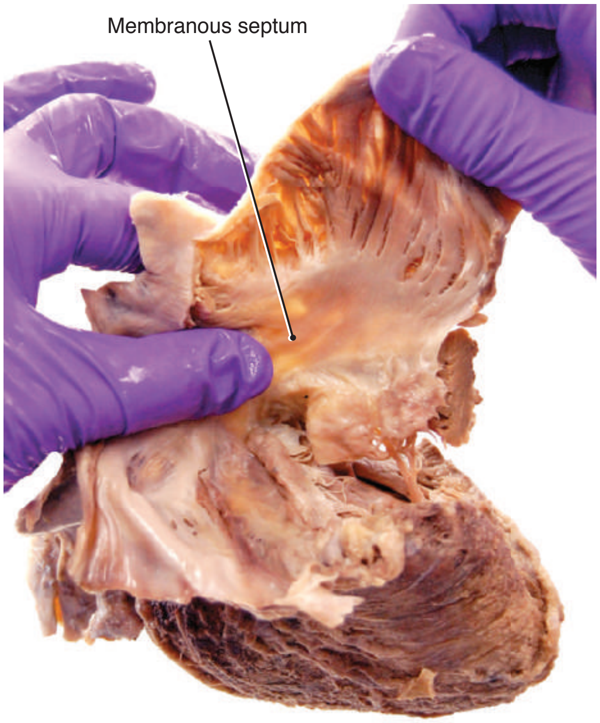


Fig. 6.24 Anterior atrial wall is lifted upward, and with a light behind it (transillumination), the membranous septum is seen.



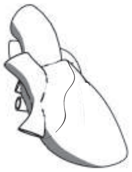


Fig. 6.25 Right atrium reflected with dissector's left thumb palpating the membranous septum.

Left Atrium

- Incise the left atrium laterally, making a horizontal incision from the right to the left pulmonary veins (Fig. 6.26).
- With forceps, reflect the flap made by the lateral incision in the left atrium, and observe within the chamber a smooth surface and limited number of pectinate muscles in the left auricle (Fig. 6.27 and Plate 6.2).

Right Ventricle

The following two techniques are used to expose the contents of the right ventricle:

Technique 1:

- Open the right ventricle by making an incision through the right atrium to expose fully the tricuspid valve toward the right ventricle (ventricular inlet) (Fig. 6.28).
- Make a second incision from the pulmonary valve to the apex of the right ventricle (ventricular outlet). The major problem with this technique is that the moderator band and RCA are often cut (Fig. 6.29).

Technique 2:

- Make a small, circular incision a few centimeters below the subpulmonary infundibulum. This area typically is occupied by the right ventricular free wall (Fig. 6.30).
- Carefully, start cutting larger pieces of the right ventricular free wall, keeping in mind not to cut the moderator band (Fig. 6.31 and Plate 6.3).
- Identify the moderator band, cut around the papillary muscle toward the tricuspid valve, and expose as much of the right ventricle as possible (Fig. 6.32).

DISSECTION TIP

The majority of hearts have a significant amount of coagulated blood around the cordae tendineae and the papillary muscles (Fig. 6.33). With forceps, carefully clean out the coagulated blood (Fig. 6.34). Water also may be run through the heart to aid in this cleaning process.

- Identify the anterior, inferior, and septal leaflets of the tricuspid valve. Observe that the leaflets are anchored to papillary muscles within the ventricle by slender, tough, chordae tendineae (see Fig. 6.34).
- Identify the large **anterior papillary** muscle.
- Posterior and inferior to this muscle is the **posterior papillary muscle.**
- The **septal papillary muscle** may consist of several small, septal papillary muscles arising from the interventricular septum, with short chordae tendineae

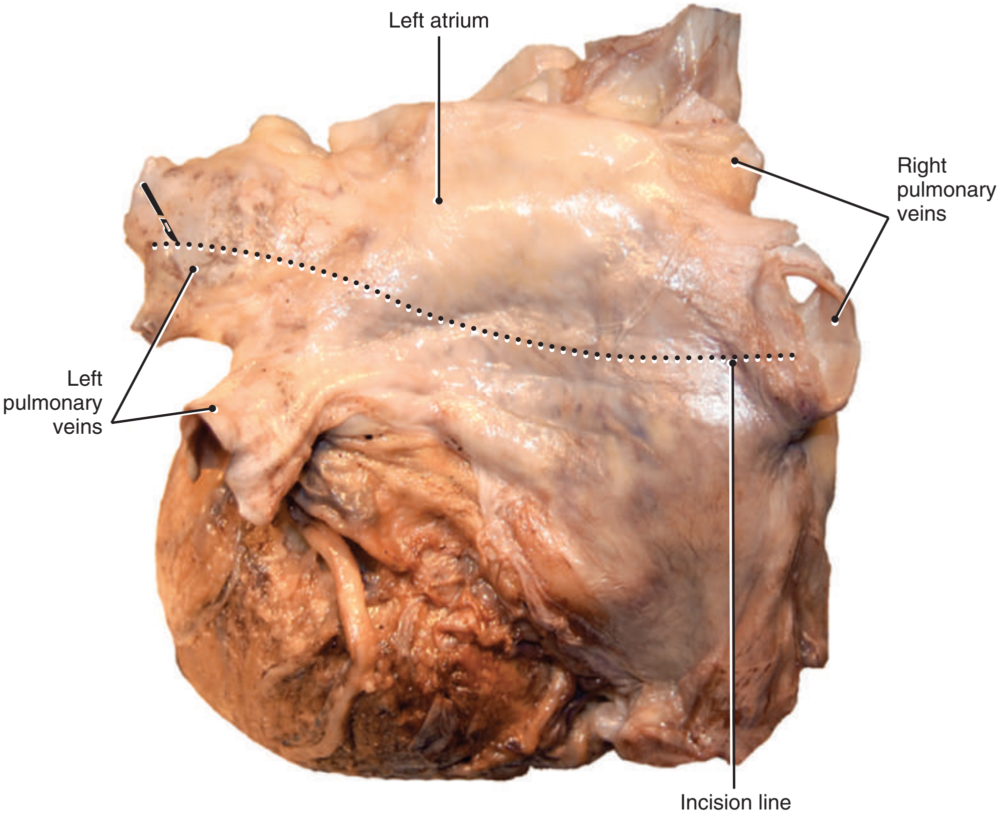
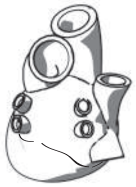

Left atrium
Right pulmonary veins
Left pulmonary veins
Incision line

Fig. 6.26 Base of heart with outline used for making incision to see contents of the left atrium.



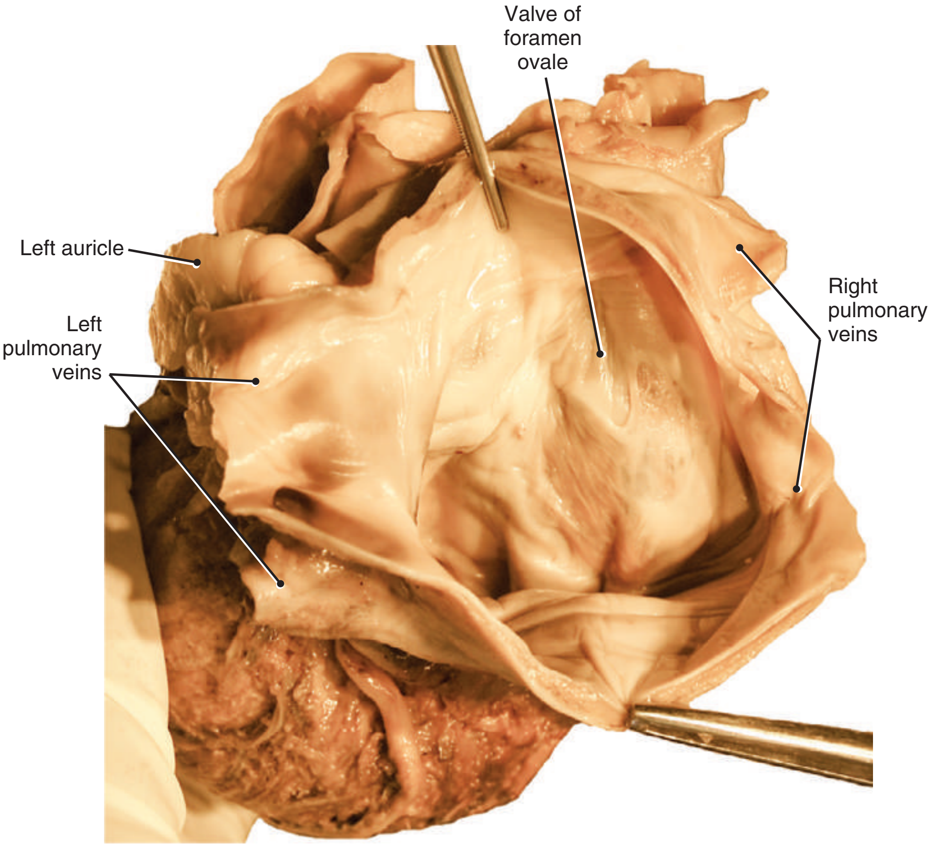

Valve of foramen ovale
Left auricle
Left pulmonary veins
Right pulmonary veins

Fig. 6.27 Left atrium incised superiorly, revealing internal structures.

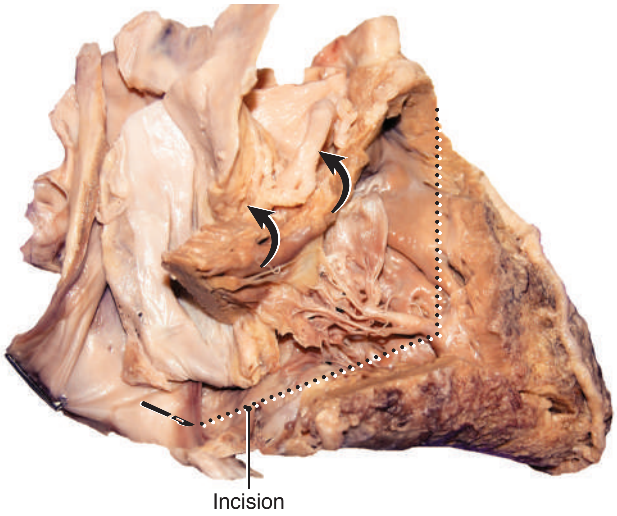
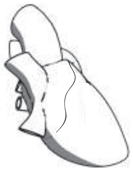


Fig. 6.28 Deep dissection of right ventricle using V-shaped incisions revealing internal structures.



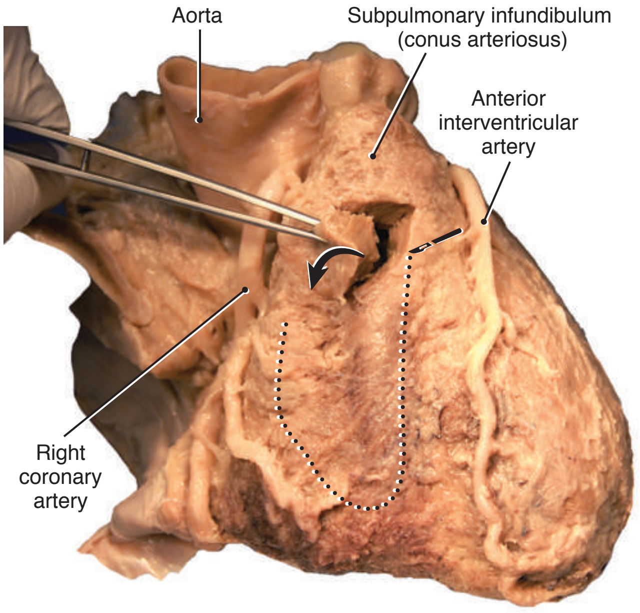
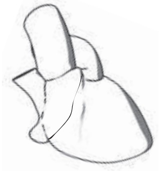

Aorta
Subpulmonary infundibulum (conus arteriosus)
Anterior interventricular artery
Right coronary artery

Fig. 6.30 Transverse and vertical incision into right ventricle, creating window into conus arteriosus; *dotted line* shows continuation of incision.



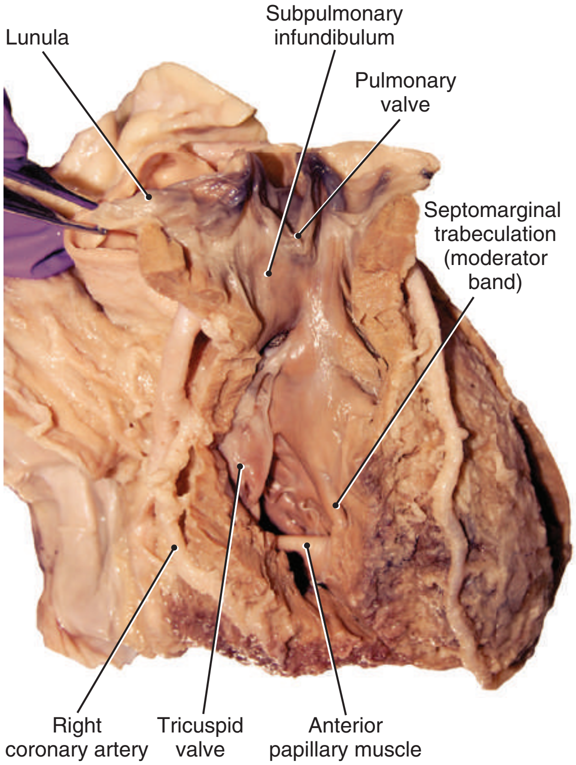
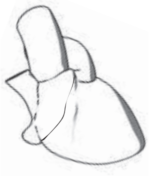

Lunula
Subpulmonary infundibulum
Pulmonary valve
Septomarginal trabeculation (moderator band)
Right coronary artery
Tricuspid valve
Anterior papillary muscle

Fig. 6.29 Right ventricle reflected away from apex and in line with pulmonary valve; anterior interventricular artery.



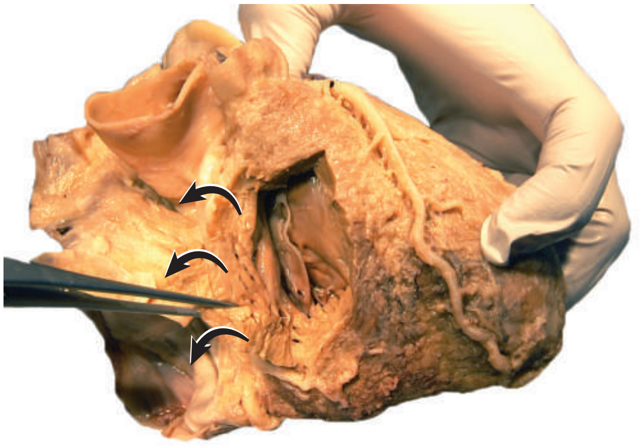


Fig. 6.31 Reflected anterior wall of right ventricle revealing internal structures.

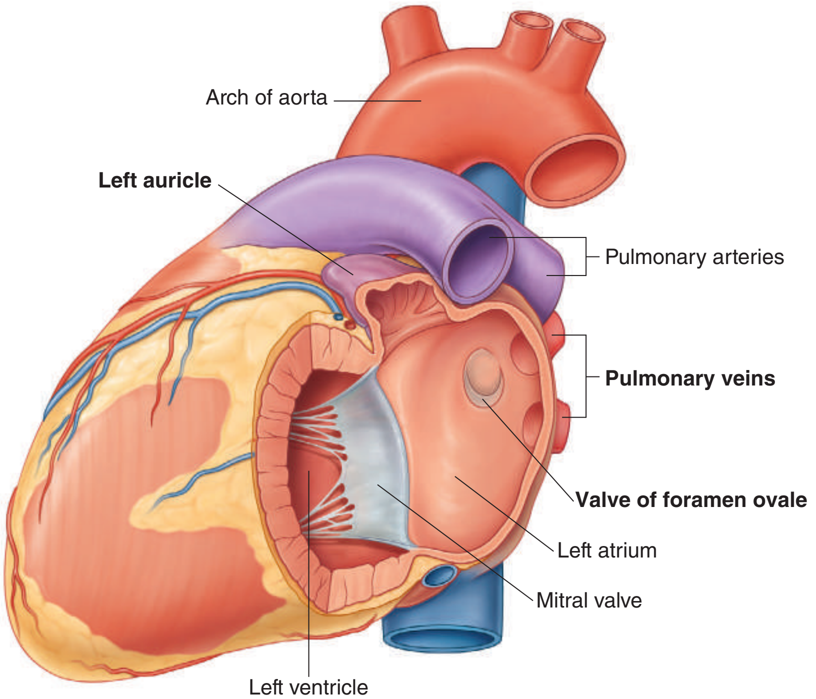

Arch of aorta
Left auricle
Pulmonary arteries
Pulmonary veins
Valve of foramen ovale
Left atrium
Mitral valve
Left ventricle

Plate 6.2 A view of the structures of the left atrium.

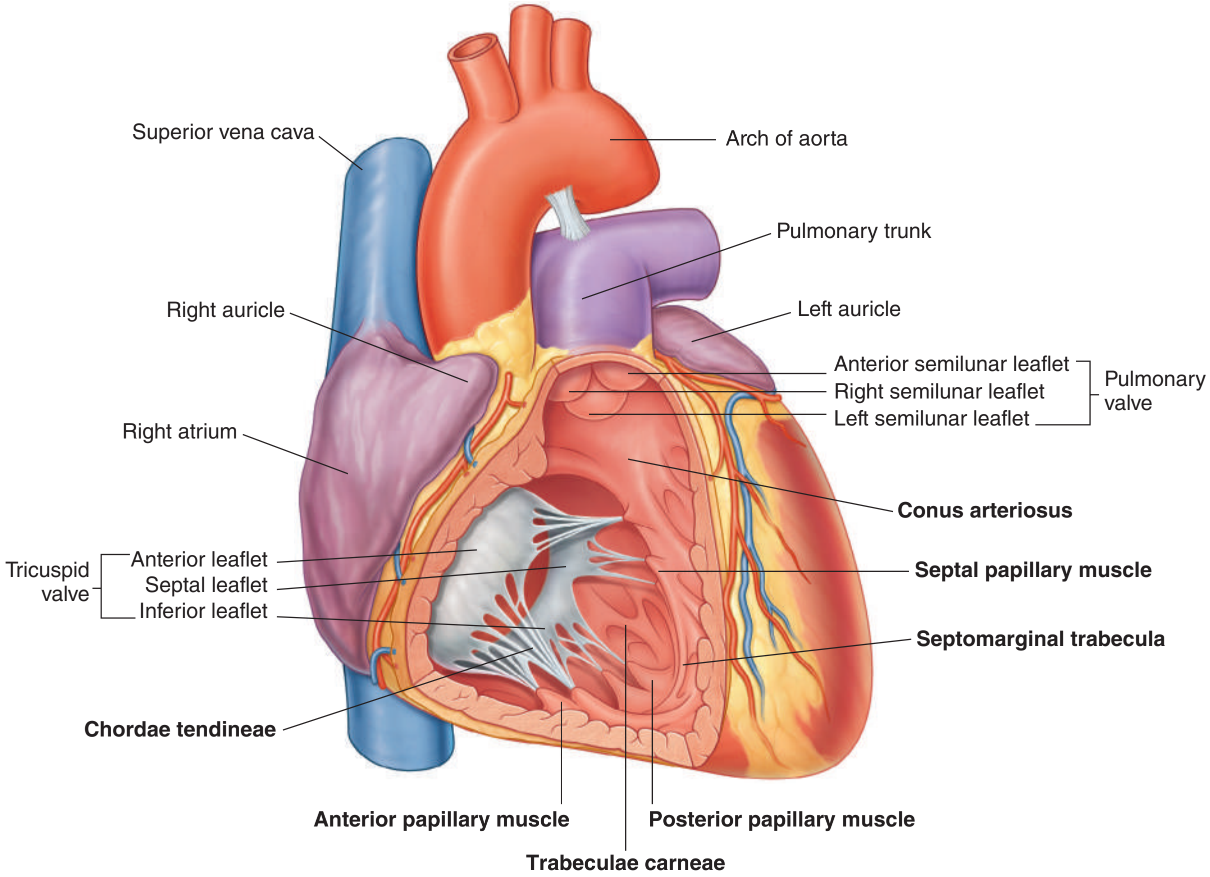

Superior vena cava
Arch of aorta
Pulmonary trunk
Right auricle
Left auricle
Anterior semilunar leaflet
Right semilunar leaflet
Left semilunar leaflet
Pulmonary valve
Right atrium
Conus arteriosus
Tricuspid valve
Anterior leaflet
Septal leaflet
Inferior leaflet
Septal papillary muscle
Septomarginal trabecula
Chordae tendineae
Anterior papillary muscle
Posterior papillary muscle
Trabeculae carneae

Plate 6.3 A view of the structures of the right ventricle.

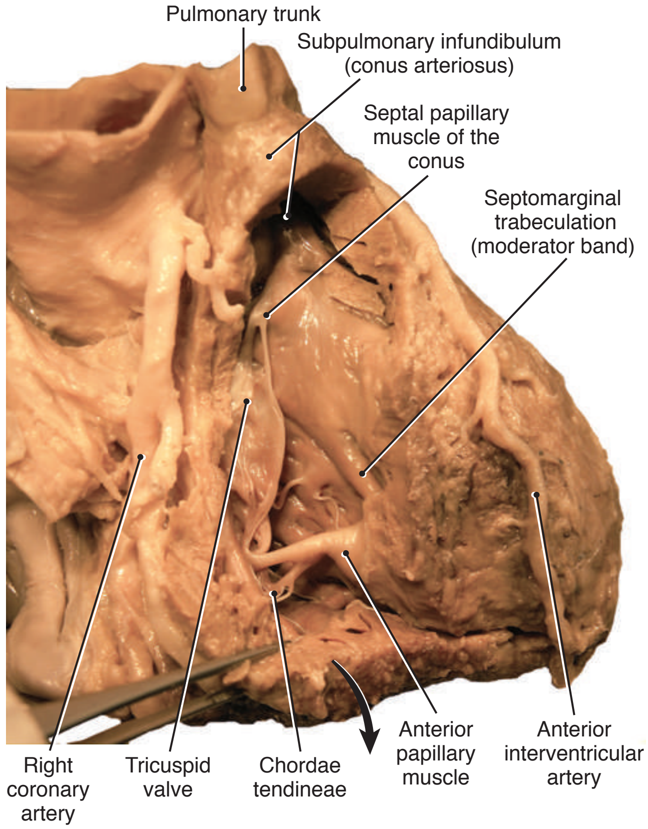
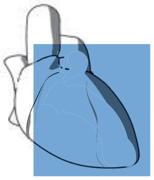

Pulmonary trunk
Subpulmonary infundibulum (conus arteriosus)
Septal papillary muscle of the conus
Septomarginal trabeculation (moderator band)
Right coronary artery
Tricuspid valve
Chordae tendineae
Anterior papillary muscle
Anterior interventricular artery

Fig. 6.32 Reflected anterior wall of right ventricle revealing internal structures.



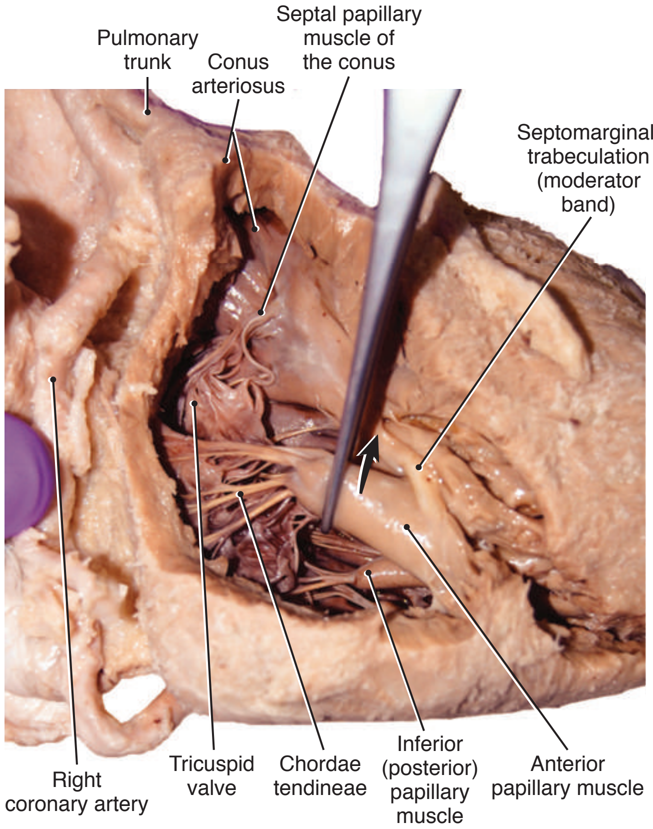
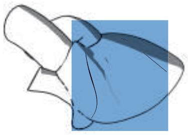

Pulmonary trunk
Conus arteriosus
Septal papillary muscle of the conus
Septomarginal trabeculation (moderator band)
Right coronary artery
Tricuspid valve
Chordae tendineae
Inferior (posterior) papillary muscle
Anterior papillary muscle

Fig. 6.34 Reflected anterior wall of right ventricle revealing internal structures.



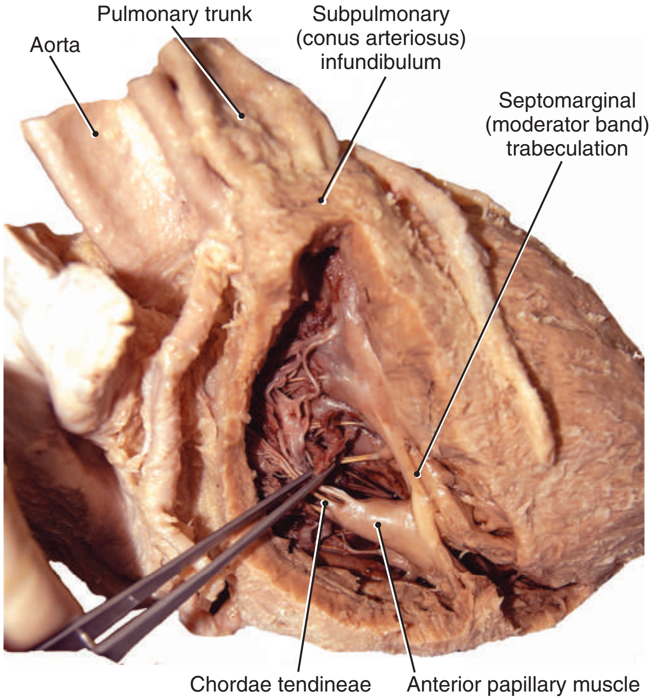
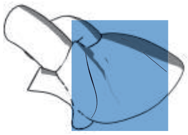

Aorta
Pulmonary trunk
Subpulmonary (conus arteriosus) infundibulum
Septomarginal (moderator band) trabeculation
Chordae tendineae
Anterior papillary muscle

Fig. 6.33 Reflected anterior wall of the right ventricle revealing internal structures.



passing to the septal leaflet of the valve. The highest and largest is called the septal papillary muscle of the conus, or of Luschka or Lancisi (see Fig. 6.34).

- Note the thick, irregular-shaped bundles of muscle within the right ventricle, the *trabeculae carneae*. The *moderator band* (or septomarginal trabeculation) passes from the muscular interventricular septum to the base of the anterior papillary muscle.
- If Technique 2 was used to open right ventricle, now cut through the pulmonary trunk.
- Refer to Fig. 6.29. Note that the three semilunar-shaped leaflets join together at the commissures.
- Note the *lunula* (free margin) and nodule of each leaflet. Observe the horizontal muscle tissue in which the pulmonary (pulmonic) valve sits; this is the subpulmonary muscular infundibulum.
- The area between the septal papillary muscle of the conus and subpulmonary infundibulum is demarcated by the crista supraventricularis.

Left Ventricle

- Identify the right coronary leaflet, the noncoronary leaflet, and the left coronary leaflet of the aortic valve (Fig. 6.35).

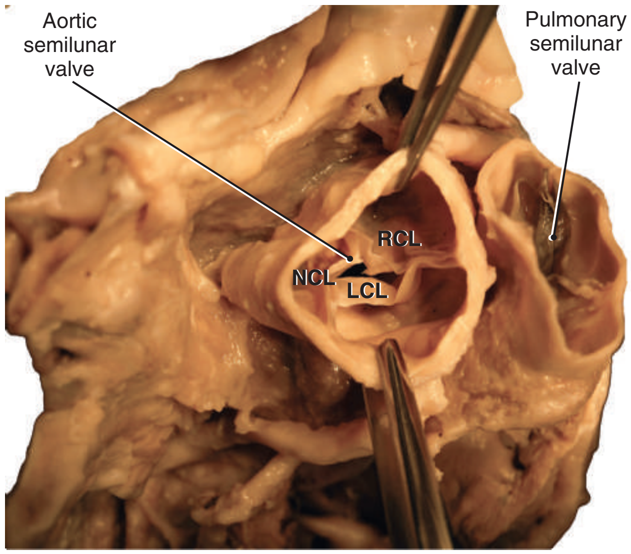


Fig. 6.35 Aorta and pulmonary vessels transected superior to base of heart revealing their valves, respectively. *LCL,* left coronary leaflet; *NCL,* noncoronary leaflet; *RCL,* right coronary leaflet.

- Make a parallel incision from the anterior interventricular artery to the bifurcation of the left coronary artery into left anterior interventricular and coronary circumflex arteries (Figs. 6.36 and 6.37).
- With your fingers or a retractor, open the left ventricle and observe the muscular ridges, the trabeculae carneae (Fig. 6.38).
- Identify the mitral valve (left AV valve) with its two leaflets, an anterior and a posterior leaflet attaching by chordae tendineae to two papillary muscles, the inferomedial (posteromedial) papillary muscle (closer to intraventricular septum, *septophilic*) and the anterolateral papillary muscle (farther away from the intraventricular septum, *septophobic*) (see Fig. 6.38).
- Make a vertical incision toward the aorta and cut through the aortic valve (Fig. 6.39).
- Identify the leaflets of the aortic valve and the lunula (free margin) and nodule of each leaflet. Identify the ostia of the coronary arteries and the depressions in the wall of the aorta, the "aortic sinuses of Valsalva."
- Beneath the noncoronary leaflet of the aorta, identify the membranous portion of the interventricular septum (Fig. 6.40).

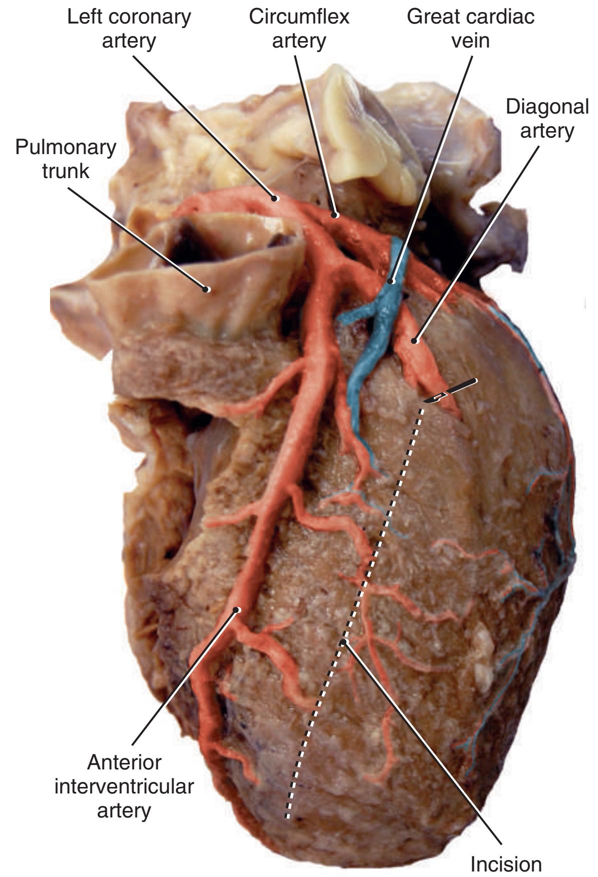


Fig. 6.36 Lateral view with vertical tilt revealing the left coronary artery and dominant branches, with tracing *(dotted line)* for incision into the left ventricle.

- Observe the leaflets of the mitral valve and the aortic-mitral valve continuity (Fig. 6.40).
- Notice the layer of lighter-colored tissue, which appears to travel inferiorly down the interventricular septum, between the coronary leaflet and the noncoronary leaflet of the aorta. This tissue forms the left bundle branch of the cardiac conduction system. Some of its fibers may be seen crossing the ventricular lumen freely as so-called false tendons (see Figs. 6.40 and 6.41 and Plate 6.4).

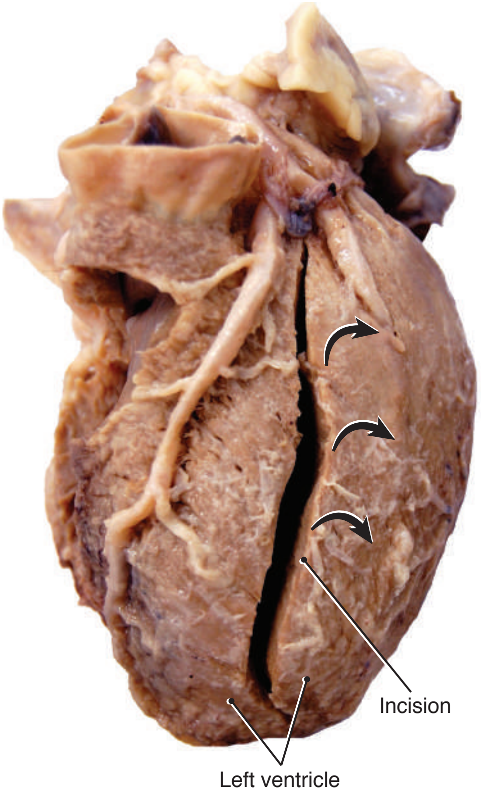

Incision
Left ventricle

Fig. 6.37 Lateral view with vertical tilt revealing the left coronary artery and dominant branches, with incision into the left ventricle.

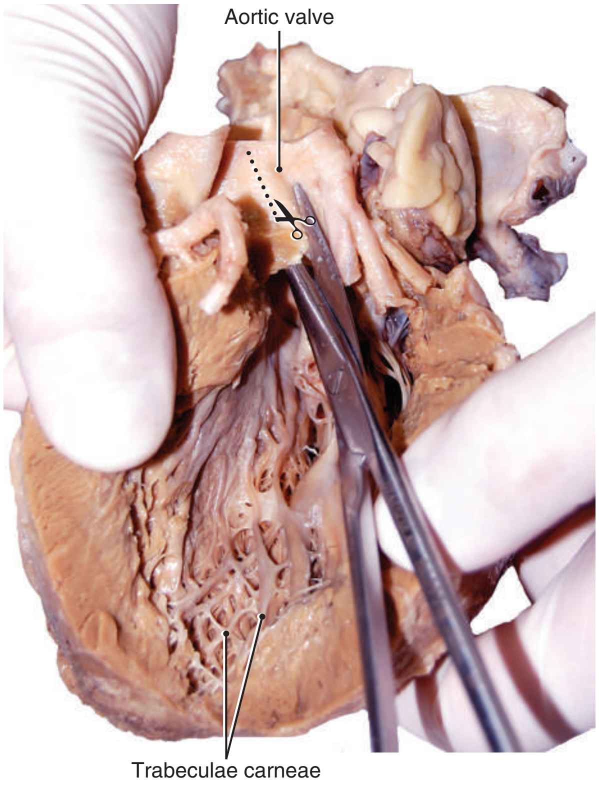

Aortic valve
Trabeculae carneae

Fig. 6.39 Opened left ventricle demonstrating internal structures and the scissors incising aortic valve.

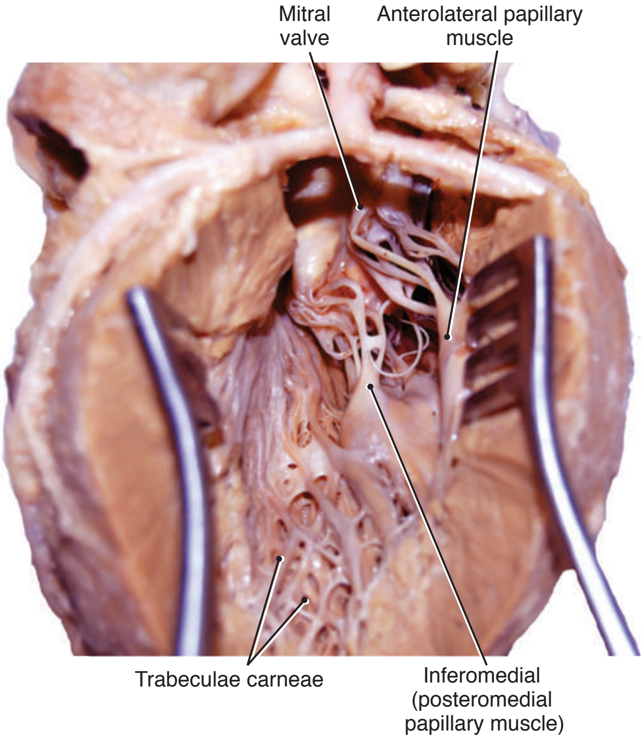
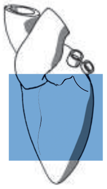

Mitral valve
Anterolateral papillary muscle
Trabeculae carneae
Inferomedial (posteromedial papillary muscle)

Fig. 6.38 Lateral view with vertical tilt revealing internal structures of the left ventricle.



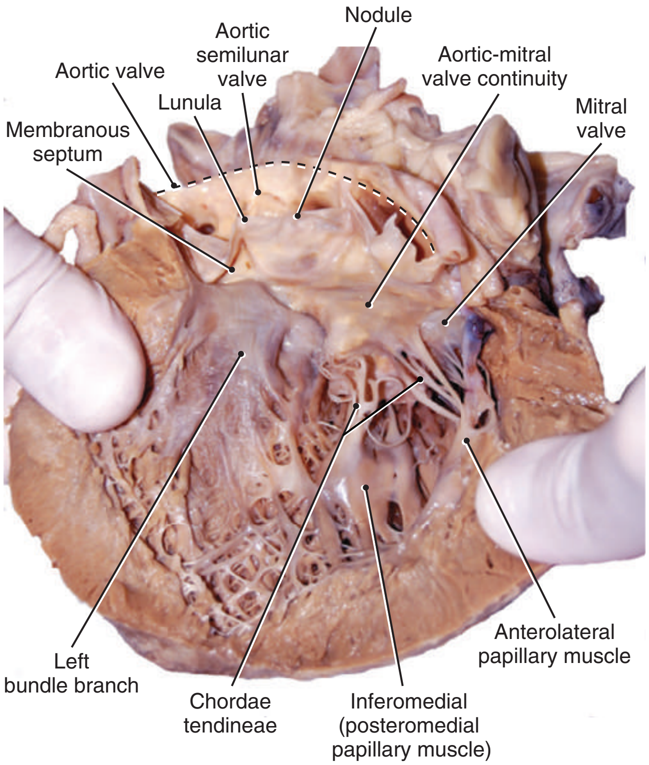

Nodule
Aortic semilunar valve
Aortic valve
Aortic-mitral valve continuity
Lunula
Mitral valve
Membranous septum
Left bundle branch
Chordae tendineae
Inferomedial (posteromedial papillary muscle)
Anterolateral papillary muscle

Fig. 6.40 Left ventricle reflected revealing internal structures, and highlighting the aortic and mitral valves.

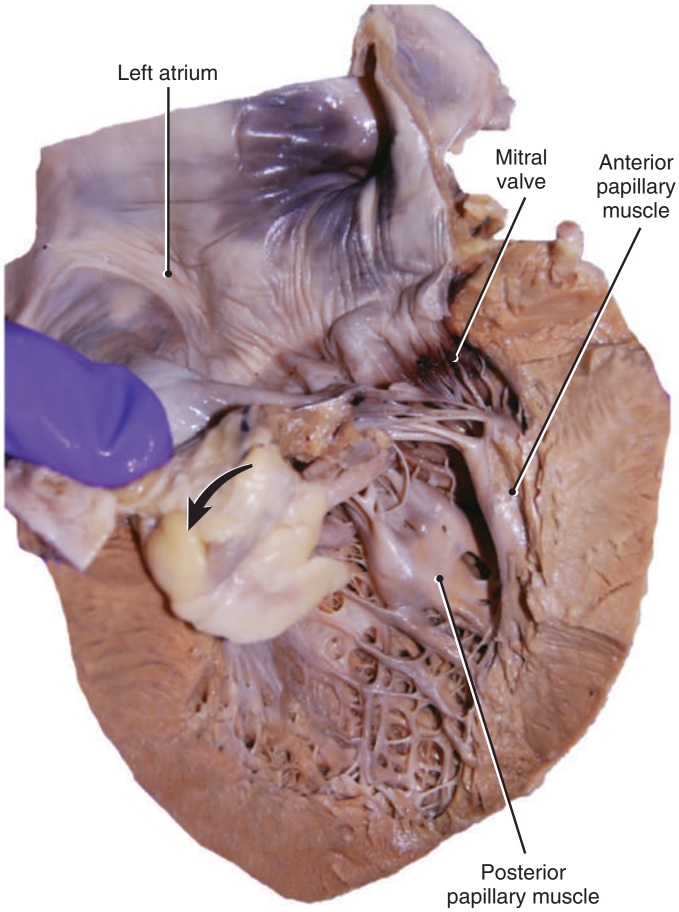

Left atrium
Mitral valve
Anterior papillary muscle
Posterior papillary muscle

Fig. 6.41 Left ventricle reflected open, revealing left atrioventricular valve and papillary muscles.

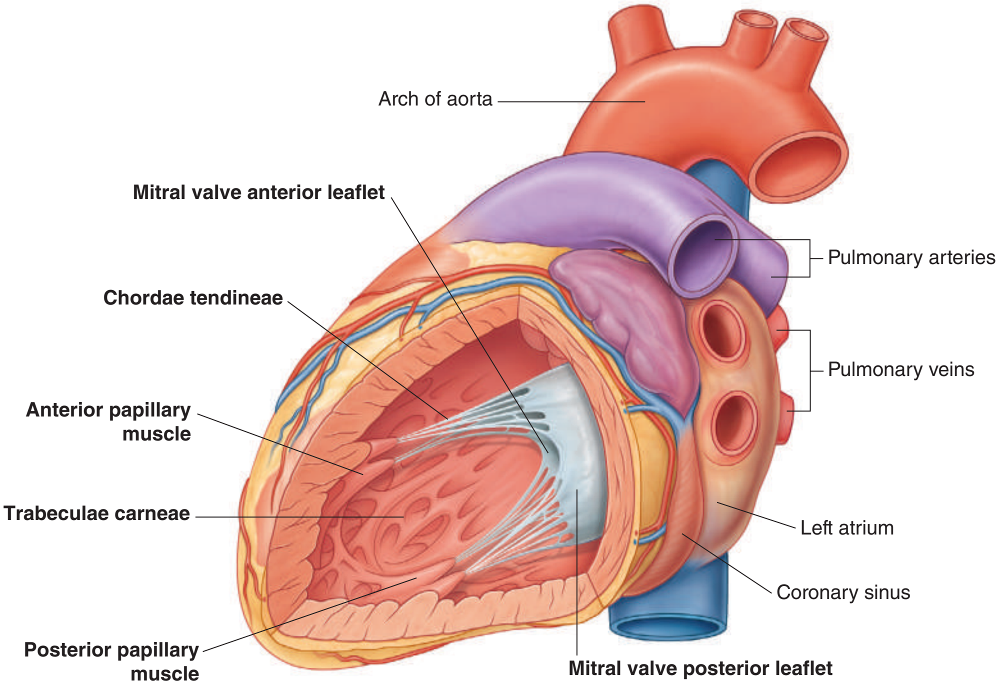

Arch of aorta
Mitral valve anterior leaflet
Pulmonary arteries
Chordae tendineae
Pulmonary veins
Anterior papillary muscle
Trabeculae carneae
Left atrium
Coronary sinus
Posterior papillary muscle
Mitral valve posterior leaflet

Plate 6.4 A view of the structures of the left ventricle.

LABORATORY IDENTIFICATION CHECKLIST

ARTERIES

- ☐ Aorta
- ☐ Common carotid
- ☐ Brachiocephalic trunk
- ☐ Pulmonary
- ☐ Left coronary
- ☐ Anterior interventricular
- ☐ Circumflex
- ☐ Interventricular septal branches
- ☐ Right coronary
- ☐ Marginal
- ☐ Sinu-atrial (SA) nodal
- ☐ Atrioventricular (AV) nodal
- ☐ Inferior (posterior) interventricular

VEINS

- ☐ Superior vena cava
- ☐ Inferior vena cava and eustachian valve
- ☐ Right and left pulmonary veins
- ☐ Coronary sinus and thebesian valve
- ☐ Great cardiac
- ☐ Middle cardiac
- ☐ Small cardiac

HEART

- ☐ Right atrium
  - ☐ Right auricle
  - ☐ Superior vena cava
  - ☐ Inferior vena cava
  - ☐ Fossa ovalis
  - ☐ Opening of coronary sinus
  - ☐ Crista terminalis
  - ☐ Pectinate muscle
  - ☐ Sinus venosus region (smooth aspect)
- ☐ Right ventricle
  - ☐ Right atrioventricular (AV) valve, or tricuspid valve
  - ☐ Chordae tendineae
  - ☐ Anterior papillary muscle
  - ☐ Posterior papillary muscle
  - ☐ Septal papillary muscle
  - ☐ Septomarginal trabeculation (moderator band)
  - ☐ Interventricular septum
  - ☐ Trabeculae carneae
- ☐ Subpulmonary infundibulum (conus arteriosus)
  - ☐ Pulmonary (pulmonic) valve
- ☐ Left atrium
- ☐ Left auricle
- ☐ Right and left pulmonary veins
- ☐ Left atrioventricular (AV) valve, or bicuspid/mitral valve
- ☐ Left ventricle
- ☐ Aortic valve
  - ☐ Chordae tendineae
  - ☐ Anterolateral papillary muscle
  - ☐ Inferomedial (posteromedial) papillary muscle
  - ☐ Chordae tendineae
  - ☐ Trabeculae carneae

CLINICAL APPLICATIONS

THORACENTESIS

Gray's Anatomy for Students: 62, 78
Netter: 197

Clinical Application

Introduce a needle or trocar into the intrathoracic cavity, creating a conduit to allow air (pneumothorax) to escape or to help remove fluid.

Anatomic Landmarks

- *Needle:* 2nd intercostal space at midclavicular line
  Skin
  Subcutaneous
  External intercostal fascia/muscle
  Internal intercostal fascia/muscle
  Parietal pleura
- *Tube:* 5th intercostal space at midaxillary line
  Skin
  Subcutaneous tissue
  Inferior angle of scapula
  Lateral pectoralis major border
  Lateral breast tissue
  Intercostal muscles
  Parietal pleura

Note: Needle placement for pneumothorax is 2nd intercostal space at midclavicular line; tube placement is at midaxillary line (Fig. III.1).

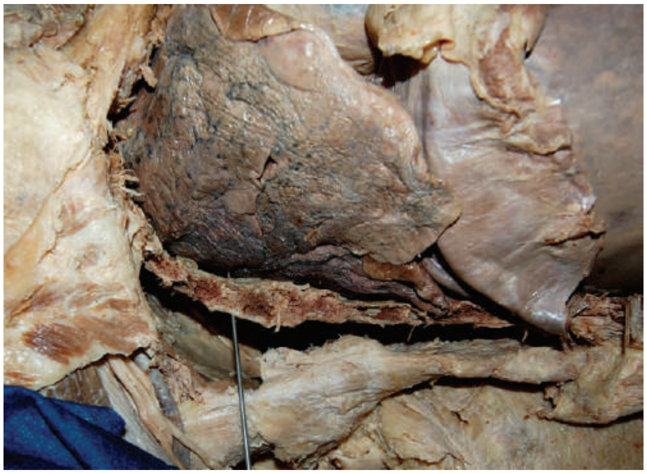


Fig. III.1

CENTRAL VENOUS LINE (CATHETERIZATION OF SUBCLAVIAN VEIN OR INTERNAL JUGULAR VEINS)

Gray's Anatomy for Students: 91, 114, 539
Netter: 38, 195

Clinical Application

Introduce a line (catheter) into the internal jugular vein above and behind the clavicle and medial to the sternocleidomastoid muscle for long-term infusion of fluids or medicines (Fig. III.2).

Anatomic Landmarks

- Skin
- Subcutaneous tissue
- Sternocleidomastoid muscle
- Clavicle
- Costoclavicular ligament
- Subclavian vein
- Anterior scalene, phenic nerve, lymphatic ducts
- Pleura

PERICARDIOCENTESIS

Gray's Anatomy for Students: 91, 92, 110
Netter: 215, 220

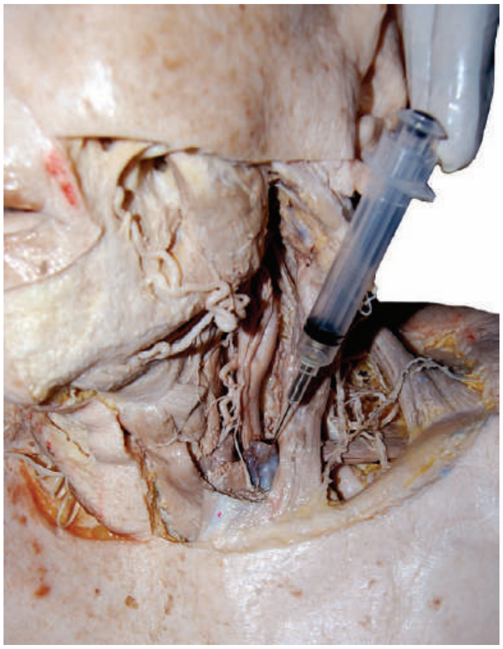


Fig. III.2

Clinical Application

Withdraw fluid from the pericardial space (Fig. III.3). *Note:* Liver, stomach, and internal thoracic artery may be in danger of injury (Fig. III.4).

Anatomic Landmarks

Subxiphoid Approach

- Xiphoid process of sternum
- Skin
- Subcutaneous tissue
- Rectus abdominis
- Pericardium
- Pericardial space

Parasternal Approach

- Left 5th intercostal space
- Left sternal border
- Skin
- Subcutaneous tissue
- External intercostal
- Internal intercostal
- Innermost intercostal
- Sternal space/pleura
- Pericardial space

OTHER LANDMARKS AND OBSERVATIONS

- Fig. III.5 shows an example of enlarged malignant lymph nodes in the axilla.
- The sternalis muscle is one of the most common variations found in the musculature of the anterior thoracic wall (Fig. III.6).
- Fig. III.7 shows a cadaver with a pacemaker.
- See Figs. III.8 to III.11 for examples of lungs with malignant lesions.
- The *myocardial bridge* is a muscular bridge that covers the anterior interventricular artery for a short distance within the myocardium. It is a common finding during dissection (Fig. III.12).
- Figs. III.13 and III.14 show the effects of myocardial infarction on the heart.

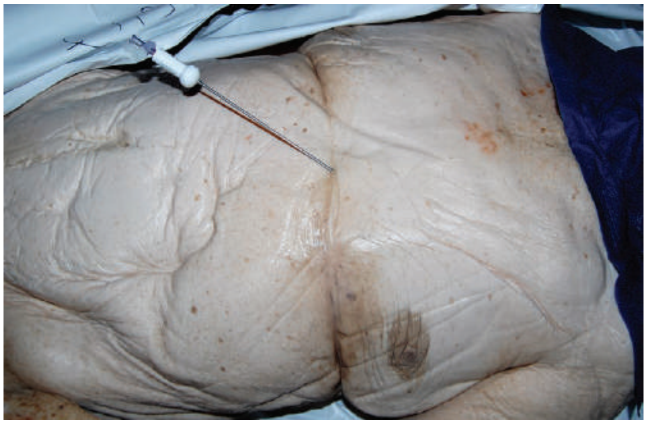


Fig. III.3

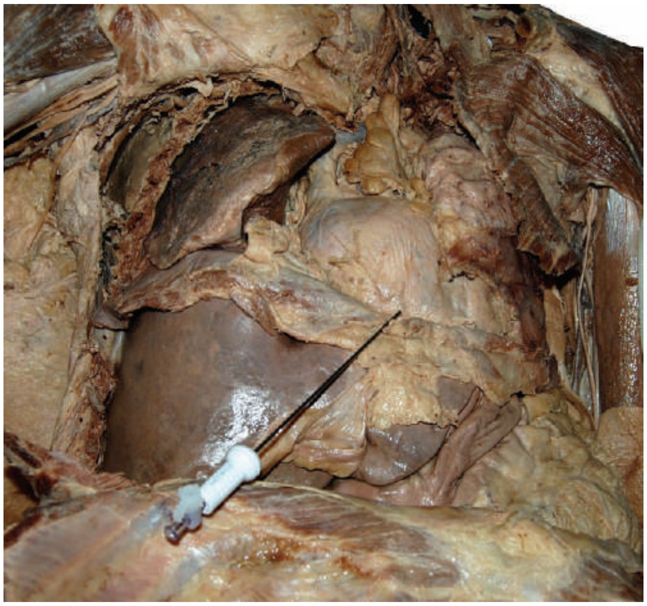


Fig. III.4

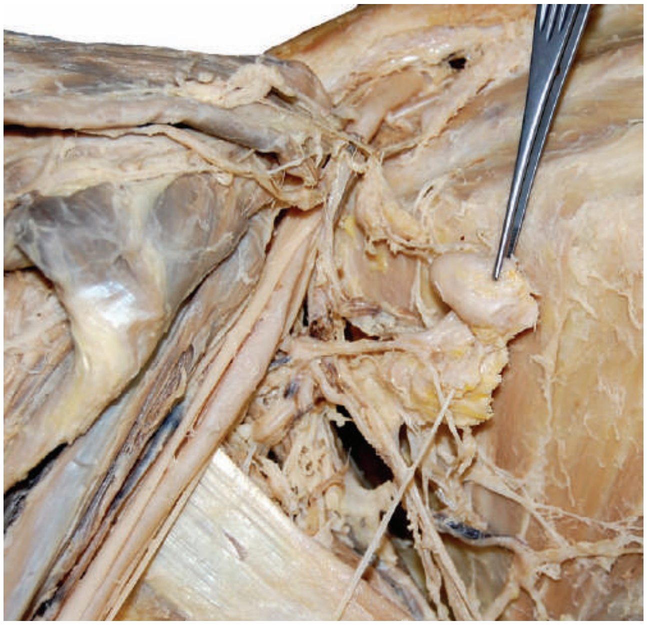


Fig. III.5

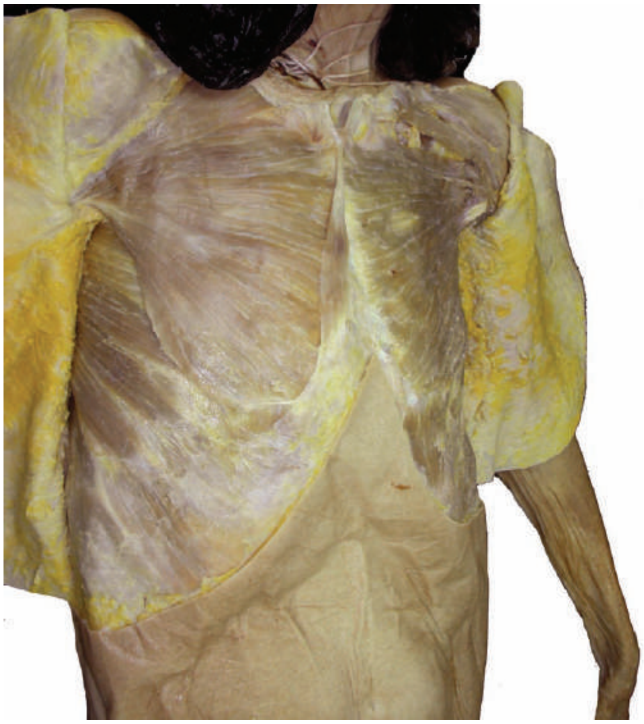


Fig. III.6

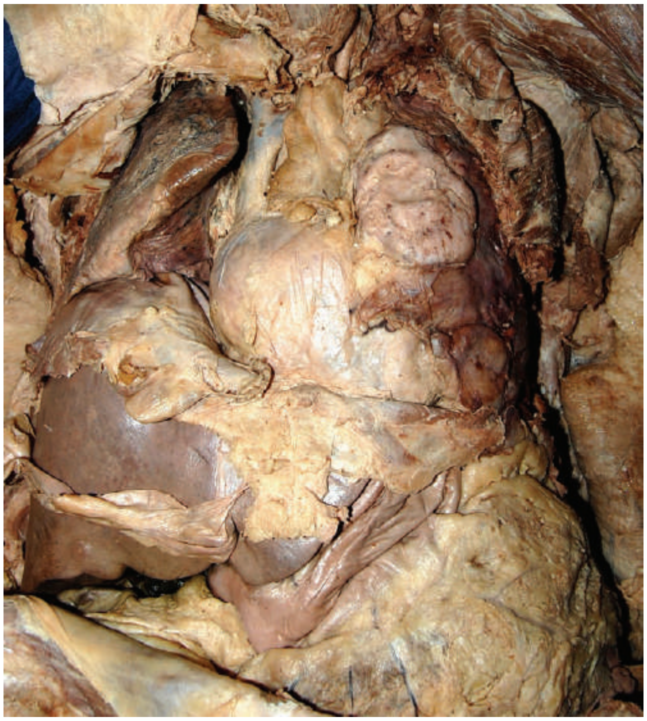


Fig. III.8

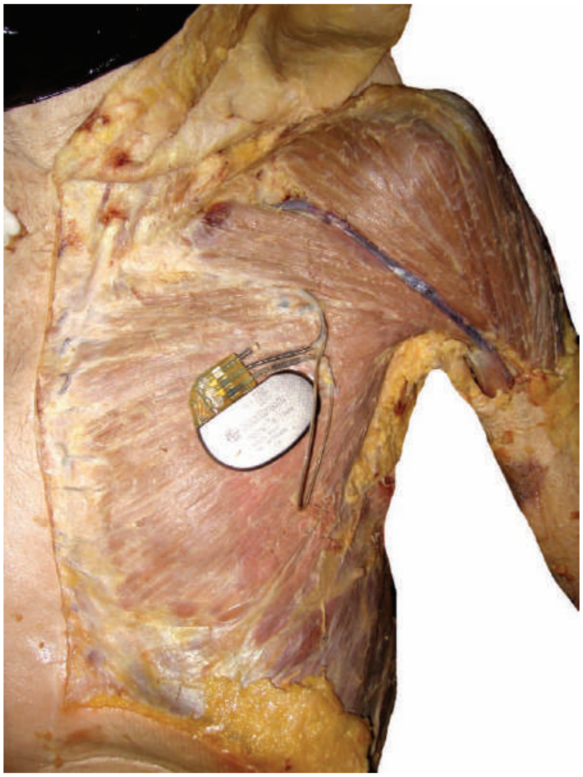


Fig. III.7

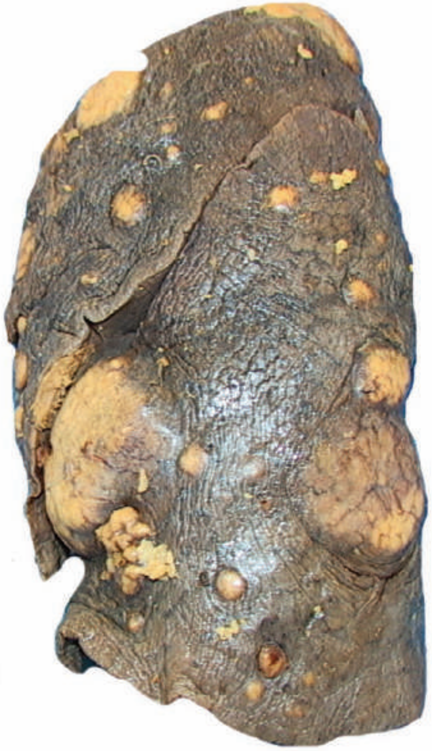


Fig. III.9

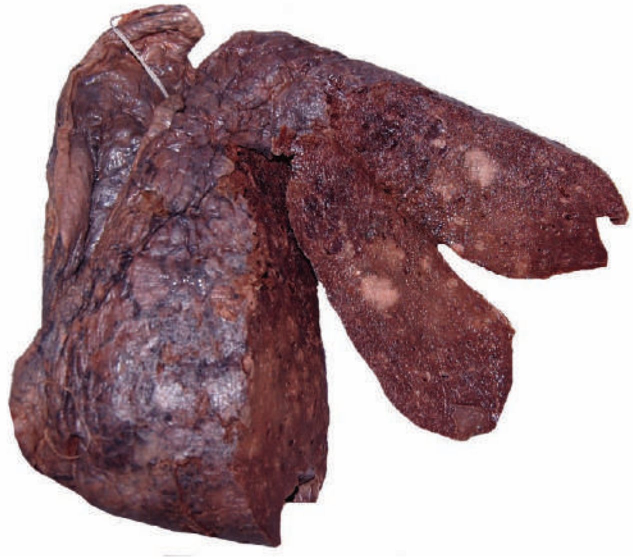


Fig. III.10

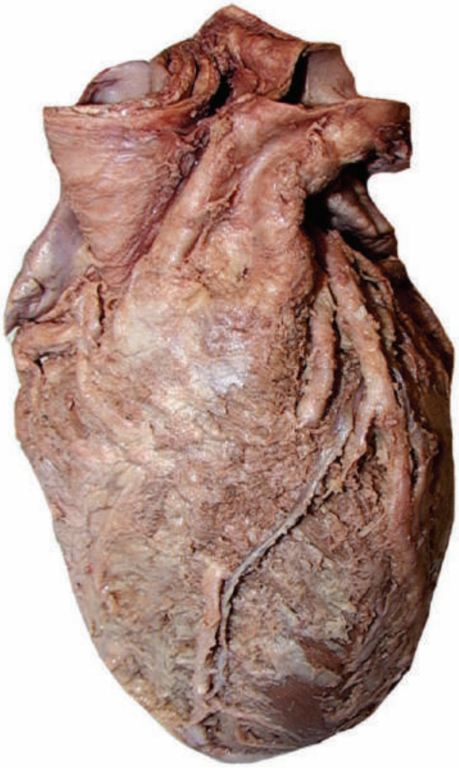


Fig. III.12

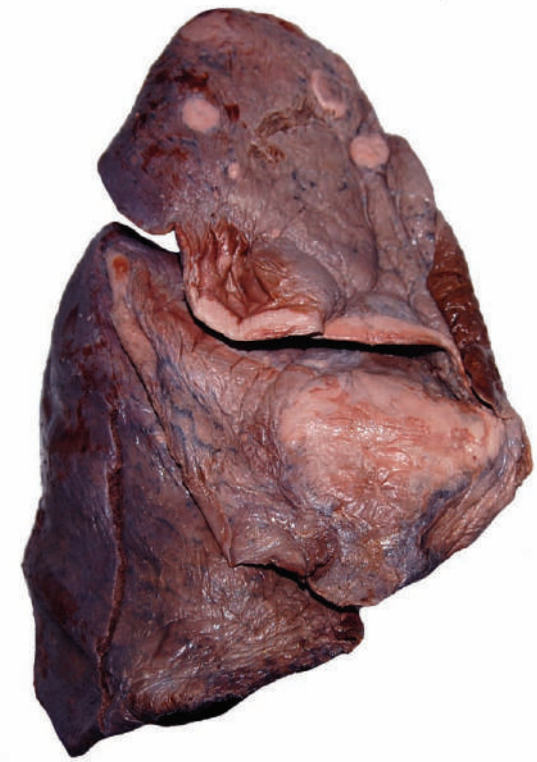


Fig. III.11

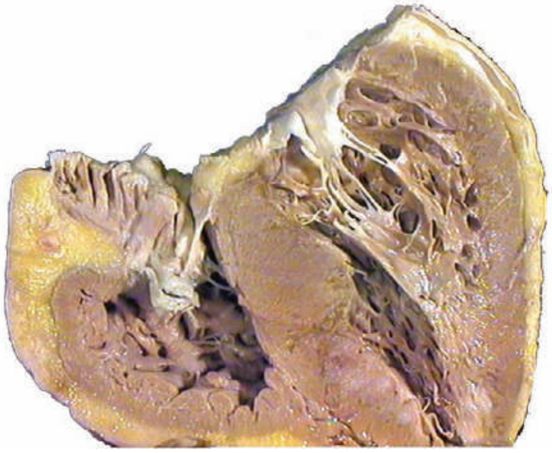


Fig. III.13

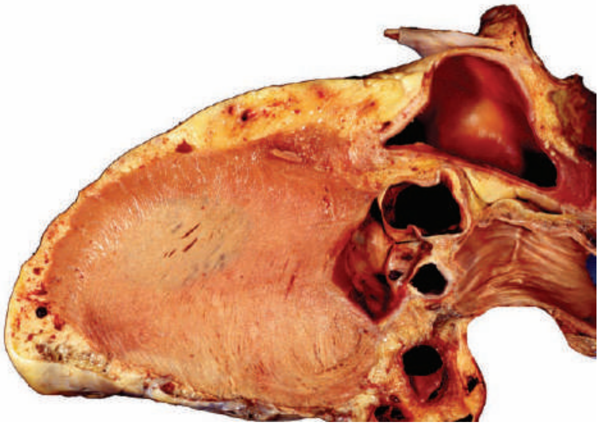


Fig. III.14

CHAPTER 7 AXILLA AND ARM

ATLAS REFERENCES

Netter: 405, 414, 419–424
McMinn: 138–145
Gray's Atlas: 384–419

BEFORE YOU BEGIN

Axillary Borders

The pectoral region should have been dissected before the study of the axilla is begun. Refer to Chapter 4 for the regional anatomy of the pectoral region and breast. Review the following borders of the axilla:

- **Anterior wall:** Pectoralis major and minor muscles and clavipectoral fascia
- **Posterior wall:** Latissimus dorsi, teres major, and subscapularis muscles
- **Lateral wall:** Humerus, short head of biceps brachii muscle, and coracobrachialis muscle
- **Medial wall:** Upper five ribs, their intercostal muscles, and adjacent serratus anterior muscle
- **Base:** Axillary fascia
- **Apex** *(cervicoaxillary canal):* Superior border of scapula, 1st rib, and clavicle

DISSECTION STEPS

- ○ **Make a skin incision from the shoulder distally to a point 2 to 3 inches (5 to 7.5 cm) above the elbow.**
- ○ **An encircling incision around the midportion of the arm allows for medial retraction of the skin from the upper arm.**
- ○ **Reflect the skin from the thorax, shoulders, axillae, and proximal portions of the arms medially to the axillary space (as shown previously in Fig. 4.4).**
- ○ **See Chapter 8 for the incisions used in the forearm.**
- ○ **Reflect the pectoralis muscles, better exposing the intercostobrachial and long thoracic nerves.**
- ○ **Identify the long thoracic nerve running over the serratus anterior muscle.**
- ○ **Note the intercostobrachial nerve emerging from the 2nd intercostal space.**

ANATOMY **NOTE**

The intercostobrachial nerve emerging from the 2nd intercostal space is the lateral cutaneous branch of the 2nd thoracic (T2) nerve crossing over the long thoracic nerve, to supply the skin of the proximal, medial aspect of the arm and axilla (Fig. 7.1).

- ○ **Preserve these two nerves.**

DISSECTION **TIP**

Adipose tissue and lymphatics occupy most of the space in the axilla. Do not attempt to remove them at this stage. Push them away from the structures you identify, and remove them at a later stage.

- ○ **Identify the fascia that invests the axillary artery, axillary vein, and the brachial plexus, called the *axillary sheath.***
- ○ **Excise the axillary sheath between the axillary artery and the brachial plexus by gently pulling away the nerves (Fig. 7.2).**
- ○ **Remove the axillary sheath, and push the adipose tissue away from the brachial plexus (Fig. 7.3).**
- ○ **Identify and clean the axillary artery and vein (Fig. 7.4).**

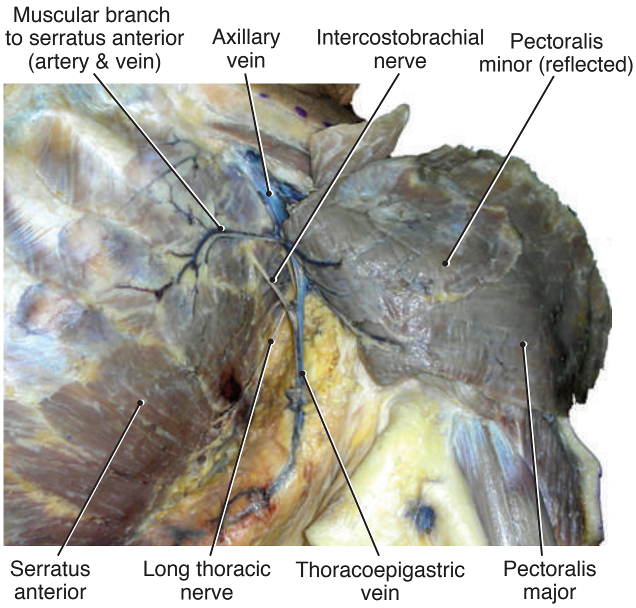

Muscular branch to serratus anterior (artery & vein)
Axillary vein
Intercostobrachial nerve
Pectoralis minor (reflected)
Serratus anterior
Long thoracic nerve
Thoracoepigastric vein
Pectoralis major

Fig. 7.1 Anterior region with skin removed and pectoralis muscles reflected, exposing intercostobrachial and long thoracic nerves.

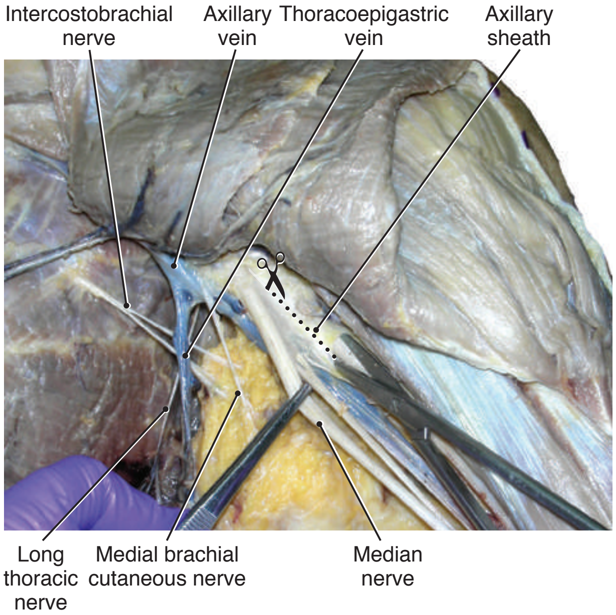
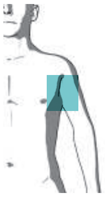

Intercostobrachial nerve
Axillary vein
Thoracoepigastric vein
Axillary sheath
Long thoracic nerve
Medial brachial cutaneous nerve
Median nerve

Fig. 7.2 Anterior axillary region with pectoralis muscles reflected, revealing excision of axillary sheath to expose terminal branches of brachial plexus.



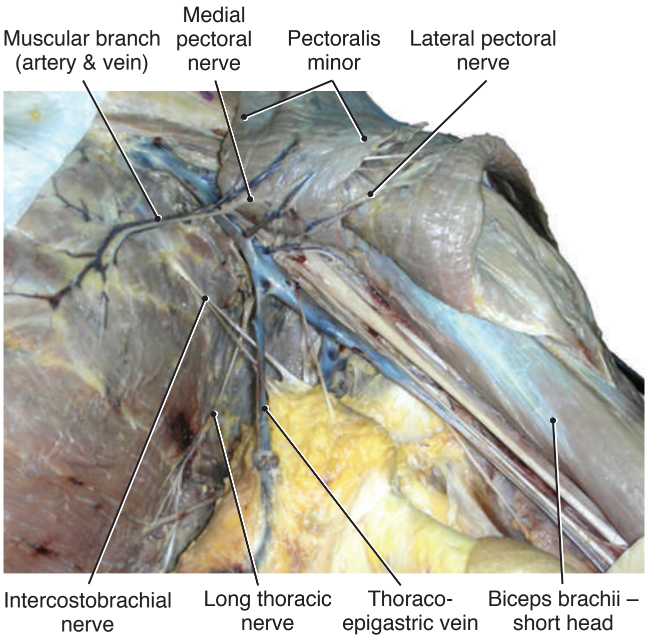

Muscular branch (artery & vein)
Medial pectoral nerve
Pectoralis minor
Lateral pectoral nerve
Intercostobrachial nerve
Long thoracic nerve
Thoraco-epigastric vein
Biceps brachii – short head

Fig. 7.3 Anterior axillary region with pectoralis muscles reflected and most of axillary sheath removed, revealing terminal branches of brachial plexus.

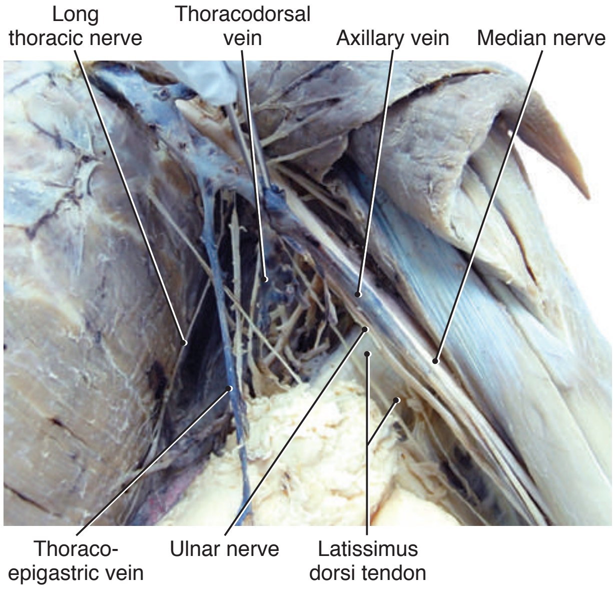

Long thoracic nerve
Thoracodorsal vein
Axillary vein
Median nerve
Thoraco-epigastric vein
Ulnar nerve
Latissimus dorsi tendon

Fig. 7.4 Anterior axillary view of deep dissection, revealing axillary vein and terminal branches of brachial plexus.

ANATOMY **NOTE**

The axillary vein is formed at the base of the axilla by the confluence of the venae comitantes of the brachial artery with the basilic vein. (Large arteries, such as the axillary or femoral, are accompanied by a single vein. Medium and smaller arteries, such as the brachial, have two or more accompanying veins, which are found on either side of the artery and are called *venae comitantes*.)

DISSECTION **TIP**

Do not attempt to identify any lymph nodes associated with the axillary vein and its tributaries. Nodes are evident and easily dissected only in cadavers with cancer. Similarly, do not attempt to identify the central axillary nodes within the fat of the central portion of the axilla. Smaller tributaries to the axillary vein that obscure the dissecting field can be removed.

- ○ **Clean the adipose tissue between the pectoralis minor muscle and brachial plexus (see Fig. 7.4).**

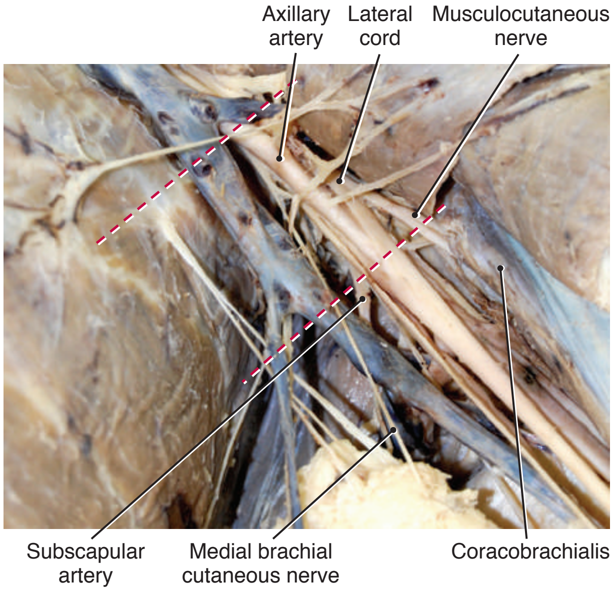
ANATOMY **NOTE**

The axillary artery extends from the lateral border of the 1st rib to the lower border of the teres major muscle. Just before it crosses the 1st rib, the artery is named the *subclavian artery.* Distal to the teres major, the name of the vessel changes to the *brachial artery.*

DISSECTION **TIP**

The arteries are named typically based on the structures they supply, not according to their origin.

- ○ **Identify the axillary artery and its three divisions, demarcated with its relationship to the pectoralis minor muscle (Fig. 7.5).**
- ○ **Identify the superior thoracic artery arising from the 1st part of the axillary artery. To identify this vessel, look for an artery penetrating the musculature of the 1st or 2nd intercostal space.**
- ○ **From the 2nd part of the axillary artery (deep to pectoralis minor muscle), identify the thoracoacromial artery and the lateral thoracic artery (see Fig. 7.5).**
- ○ **Look for the pectoral branches of the thoracoacromial artery supplying the pectoralis major and minor muscles. Do not look for the remaining branches of the thoracoacromial artery (deltoid, acromial, and clavicular).**



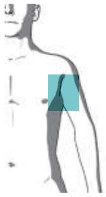


Fig. 7.5 Anterior axillary view revealing the second part of the axillary artery, thoracoacromial artery, and lateral cord. *Red dashed lines* represent the borders on the pectoralis minor muscle over the axillary artery, dividing its three portions.

DISSECTION **TIP**

The following anatomic landmarks may be helpful when identifying the branches of the axillary artery.

- **Superior thoracic artery:** 1st or 2nd intercostal spaces
- **Lateral thoracic artery:** Lateral border of pectoralis minor muscle. Often the lateral thoracic artery arises as a branch of the thoracoacromial artery.
- **Thoracoacromial artery:** 2nd part of axillary artery
- **Pectoral branches:** Look for these on the internal surface of the pectoralis major and minor muscles, and trace them backward to the axillary artery and thoracoacromial artery. The pectoral branches often originate directly from the 2nd part of the axillary artery.
- Separate the axillary artery from the branches of the brachial plexus, and remove fat from the latissimus dorsi muscle (Fig. 7.6).
- Do not remove fat deep to the axilla.
- Continue removing the axillary sheath from the brachial artery and vein, and expose the median nerve distally to the midportion of the arm (Fig. 7.7).

DISSECTION **TIP**

Exposing the branches of the brachial plexus to the midportion of the humerus allows greater mobility and facilitates the identification of structures deep in the axilla.

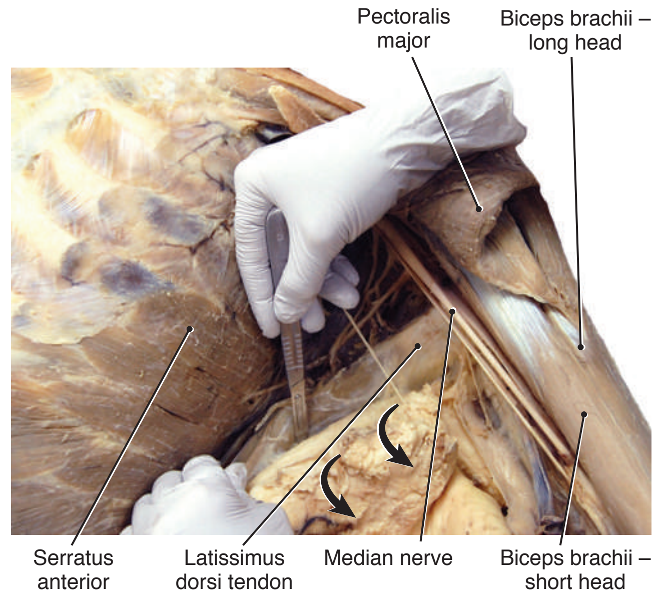

Pectoralis major
Biceps brachii – long head
Serratus anterior
Latissimus dorsi tendon
Median nerve
Biceps brachii – short head

Fig. 7.6 Anterior view revealing removal of the fat from the latissimus dorsi muscle.

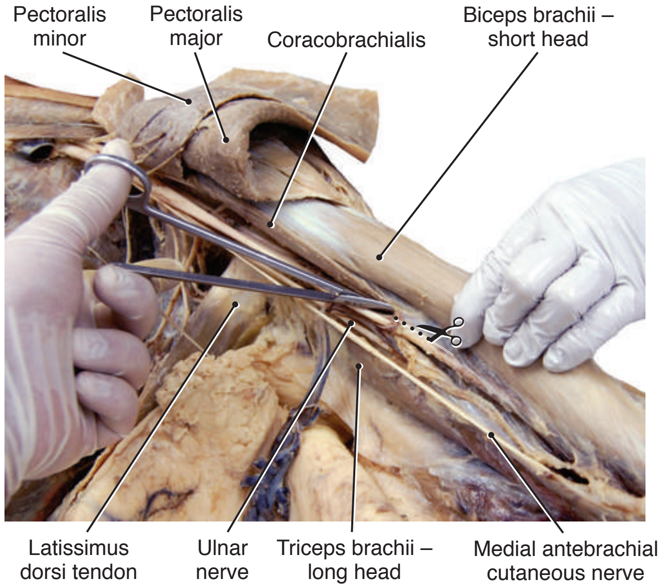
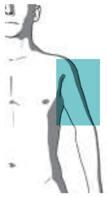

Pectoralis minor
Pectoralis major
Coracobrachialis
Biceps brachii – short head
Latissimus dorsi tendon
Ulnar nerve
Triceps brachii – long head
Medial antebrachial cutaneous nerve

Fig. 7.7 Removing the axillary sheath and soft tissue.



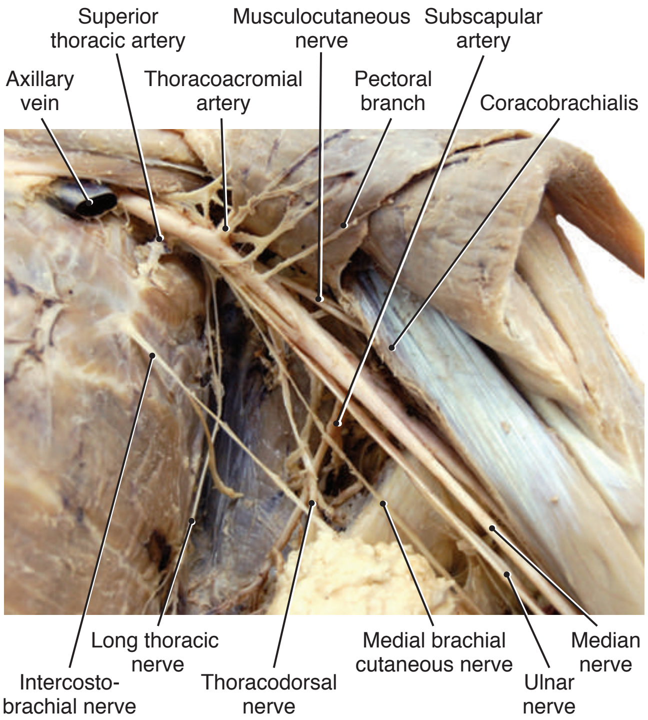

Superior thoracic artery
Musculocutaneous nerve
Subscapular artery
Axillary vein
Thoracoacromial artery
Pectoral branch
Coracobrachialis
Long thoracic nerve
Intercosto-brachial nerve
Thoracodorsal nerve
Medial brachial cutaneous nerve
Ulnar nerve
Median nerve

Fig. 7.8 Anterior axillary view with reflected pectoralis muscles, removed axillary vein, revealing the axillary artery and associated nerves.

- Cut the axillary vein at the point where the 1st part of the axillary artery originates, and reflect the vein and its tributaries toward the forearm.
- Do not completely remove the vein from the cadaver.
- Distal to the pectoralis minor muscle, from the 3rd portion of the axillary artery, identify the anterior circumflex humeral, posterior circumflex humeral, and subscapular arteries (Figs. 7.9 and 7.10).

ANATOMY **NOTE**

The subscapular artery runs vertically toward the latissimus dorsi and branches into the thoracodorsal artery, supplying the latissimus dorsi muscle, and the circumflex scapular artery, traveling posteriorly to the muscles of the posterior scapula (Figs. 7.8 and 7.9).

- Identify the subscapular artery and thoracodorsal arteries.
- Identify and clean the branches of the medial cord: the medial pectoral nerve, ulnar nerve, medial root of median nerve, medial brachial cutaneous nerve, and medial antebrachial cutaneous nerve.
- Alongside the medial antebrachial cutaneous nerve, identify the basilic vein (formed at the medial aspect of the dorsal venous arch of the hand; see Chapters 8 and 9 for hand structures).
- Trace and expose the median nerve to the elbow (see Fig. 7.9).

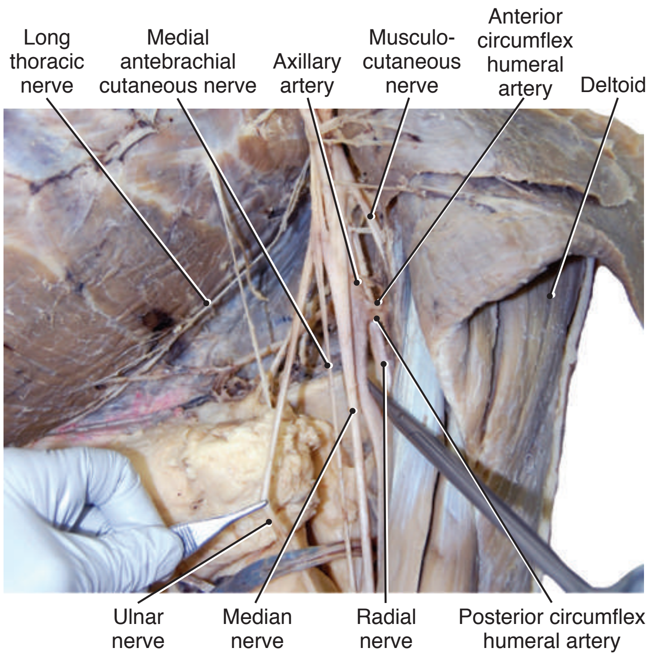

Long thoracic nerve
Medial antebrachial cutaneous nerve
Axillary artery
Musculo-cutaneous nerve
Anterior circumflex humeral artery
Deltoid
Ulnar nerve
Median nerve
Radial nerve
Posterior circumflex humeral artery

Fig. 7.9 Axillary artery and ulnar and median nerves are pulled medially to expose radial nerve and anterior and posterior circumflex humeral arteries.

DISSECTION **TIP**

ANATOMIC LANDMARKS

- **Subscapular artery:** Arises from the 3rd part of the axillary artery (pull the medial cord upward to expose it) and runs vertically down between the latissimus dorsi and subscapularis muscles.
- **Thoracodorsal artery:** Arises from the subscapular artery and continues to run downward to supply the latissimus dorsi muscle. This artery is found on the surface of the latissimus dorsi accompanied by the middle subscapular nerve (trace the artery backward to its origin).

ANATOMY **NOTE**

The brachial plexus is divided into rami, trunks, divisions, cords, and terminal branches. The rami, trunks, and divisions are identified later in the root of the neck dissection. In this dissection, you will be able to identify the cords and terminal branches of the brachial plexus. The cords are named in respect to their positions in relationship to the axillary artery. As a result, the *lateral cord* is situated lateral to the axillary artery, the *medial cord* medial to the axillary artery, and the *posterior cord* posterior (deep) to the axillary artery. The lateral cord gives off two branches: the lateral pectoral nerve supplies the pectoralis major muscle, and the musculocutaneous nerve supplies the biceps brachii, coracobrachialis, and brachialis muscles (see Fig. 7.8) (Plate 7.1).

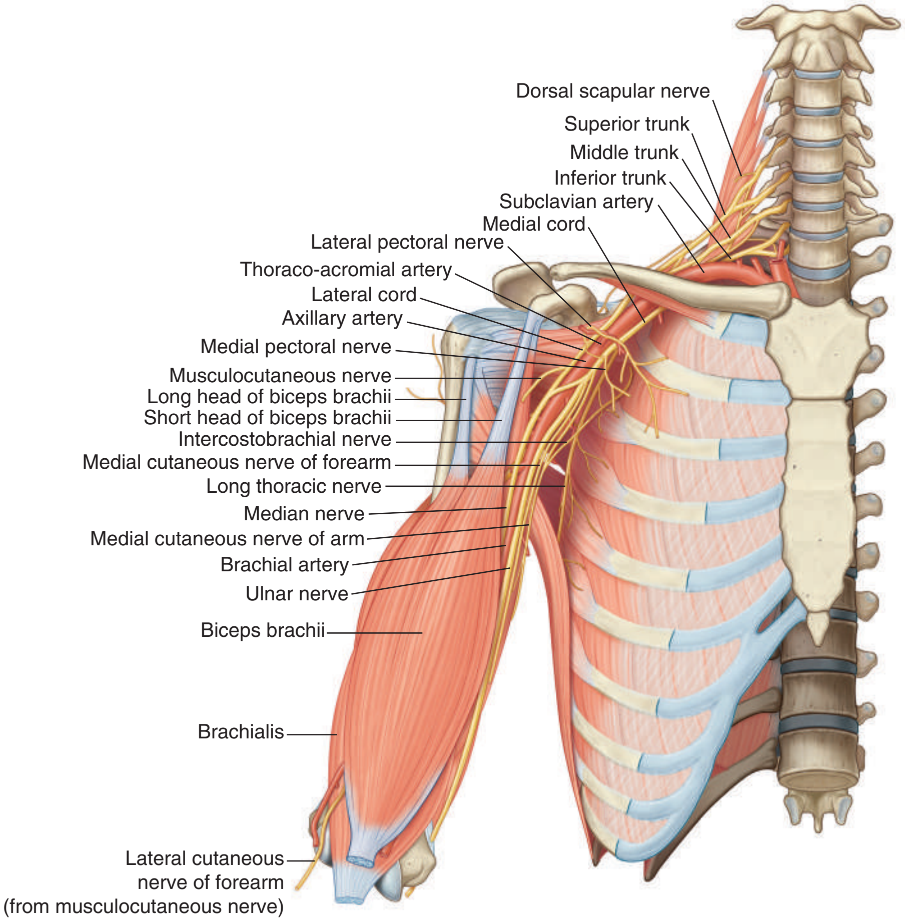

Dorsal scapular nerve
Superior trunk
Middle trunk
Inferior trunk
Subclavian artery
Medial cord
Lateral pectoral nerve
Thoraco-acromial artery
Lateral cord
Axillary artery
Medial pectoral nerve
Musculocutaneous nerve
Long head of biceps brachii
Short head of biceps brachii
Intercostobrachial nerve
Medial cutaneous nerve of forearm
Long thoracic nerve
Median nerve
Medial cutaneous nerve of arm
Brachial artery
Ulnar nerve
Biceps brachii
Brachialis
Lateral cutaneous nerve of forearm (from musculocutaneous nerve)

Plate 7.1 Lateral and medial cords of the brachial plexus.

DISSECTION **TIP**

A landmark for identifying the musculocutaneous nerve is that the nerve pierces the proximal portion of the coracobrachialis muscle.

DISSECTION **TIP**

ANATOMIC LANDMARKS

- **Ulnar nerve**: Look for the nerve traveling along the medial aspect of the arm, not providing any branches to the arm, and crossing posterior to the medial epicondyle.
- **Median nerve:** Look for the nerve traveling along the medial aspect of the arm without giving off any branches to the arm. It is found easily as it travels underneath the bicipital aponeurosis.
- **Medial brachial cutaneous nerve:** Runs parallel for a short distance in the arm with the medial antebrachial cutaneous nerve and is distributed to the skin of the arm. This nerve is often cut when the skin of the arm is reflected.
- **Medial antebrachial cutaneous nerve:** Runs parallel and superficial to the ulnar nerve and is distributed to the skin of the forearm. The basilic vein runs together with this nerve.

DISSECTION **TIP**

The medial brachial cutaneous nerve (medial cutaneous nerve to the arm) often is severed during the removal of the skin over the brachium. The medial antebrachial cutaneous nerve (medial cutaneous nerve to the forearm) runs parallel to the ulnar nerve. The landmark for identifying the ulnar nerve is to trace it as it crosses posterior to the medial epicondyle of the humerus. In contrast, the medial antebrachial cutaneous nerve runs more superficially and terminates in the skin of the forearm (see Fig. 7.14).

ANATOMY **NOTE**

The posterior cord gives rise to the following branches: upper, middle thoracodorsal, and lower subscapular nerves; axillary nerve; and radial nerve.

DISSECTION **TIP**

To identify the posterior cord, pull the medial cord and the axillary artery, laterally, away from the coracobrachialis muscle (Figs. 7.8 to 7.10). Look posteriorly and deep to it for the posterior cord.

- Deep to the axillary artery, identify the posterior cord.
- Identify and trace the radial nerve as it penetrates the triceps brachii.
- At the level of the surgical neck of the humerus, dissect and expose the anterior and posterior circumflex humeral arteries (see Fig. 7.10).

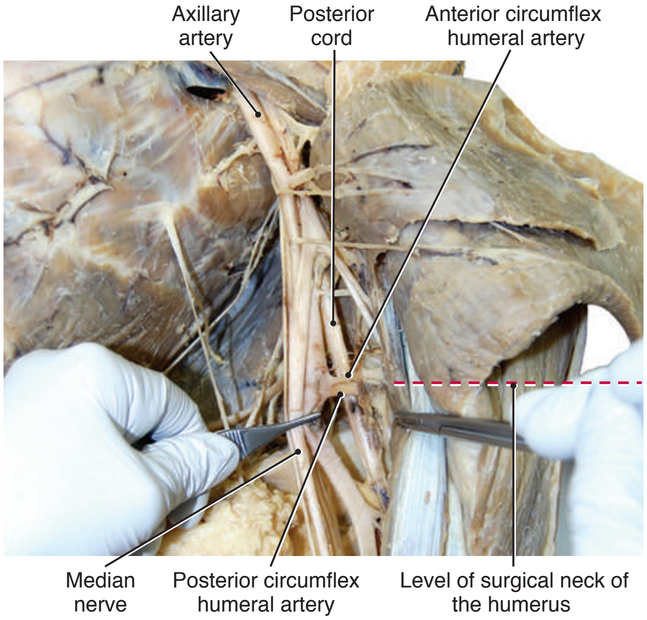

Axillary artery
Posterior cord
Anterior circumflex humeral artery
Median nerve
Posterior circumflex humeral artery
Level of surgical neck of the humerus

Fig. 7.10 Anterior axillary view with reflected pectoralis muscles, traction from axillary artery, revealing lateral cord, posterior cord, and musculocutaneous nerve. *Red dashed line* shows level of the surgical neck of the humerus.

DISSECTION **TIP**

ANATOMIC LANDMARKS

Radial nerve: Look at the medial surface of the arm for the nerve innervating the triceps brachii muscle (see Fig. 7.15). Trace the nerve backward to the axilla and posterior cord.

DISSECTION **TIP**

ANATOMIC LANDMARKS

Posterior circumflex humeral artery: Pull the axillary artery away from the coracobrachialis at the level of the surgical neck of the humerus, and identify the artery. It runs alongside the axillary nerve.

DISSECTION **TIP**

The posterior circumflex humeral artery is typically much larger than the anterior circumflex humeral artery. In some specimens, the posterior humeral artery may arise from the subscapular artery.

- Identify the axillary nerve running alongside the posterior circumflex humeral artery passing posterior to the surgical neck of the humerus to reach the quadrangular space.
- Trace the nerve backward to the posterior cord.
- Pull the medial cord upward, and observe the subscapular artery and the posterior cord of the brachial plexus (Fig. 7.11).

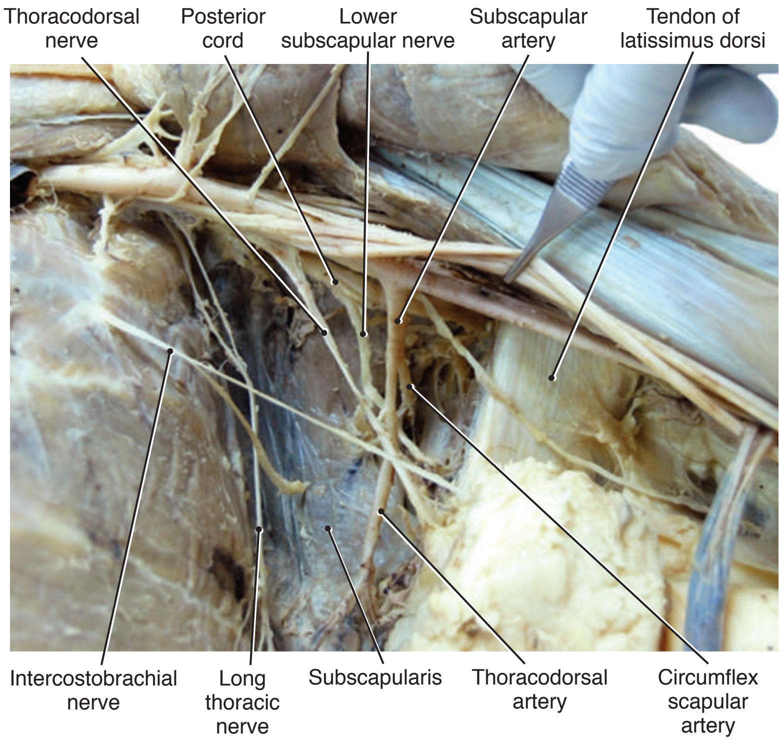
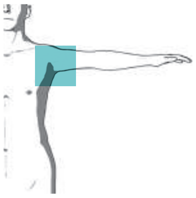

Thoracodorsal nerve
Posterior cord
Lower subscapular nerve
Subscapular artery
Tendon of latissimus dorsi
Intercostobrachial nerve
Long thoracic nerve
Subscapularis
Thoracodorsal artery
Circumflex scapular artery

Fig. 7.11 Anterior view revealing posterior structures.



- Identify the thoracodorsal nerve that supplies the latissimus dorsi muscle and runs alongside the thoracodorsal artery, which also supplies the latissimus dorsi (see Figs. 7.11 and 7.12).
- Distal to the origin of the thoracodorsal nerve, identify the lower subscapular nerve running at the lateral border of subscapularis with the scapular circumflex artery.
- Identify the scapular circumflex artery.
- Clean out the subscapularis muscle and at its deeper portion, identify the upper subscapular nerve supplying the subscapularis muscle (Figs. 7.12 and 7.13).

DISSECTION **TIP**

ANATOMIC LANDMARKS

Thoracodorsal nerve: Found on the surface of the latissimus dorsi muscle running alongside the thoracodorsal artery.

ANATOMY **NOTE**

The lower subscapular nerve supplies part of the subscapularis and the entire teres major muscle.

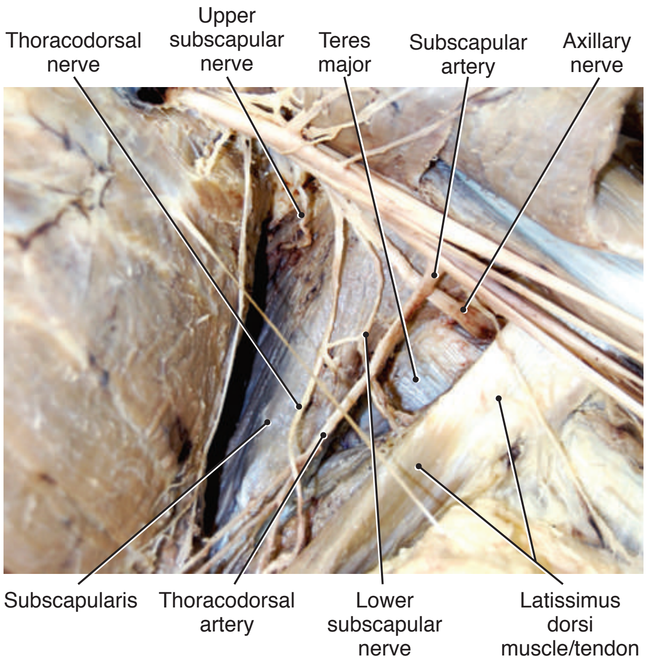
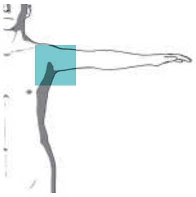

Thoracodorsal nerve
Upper subscapular nerve
Teres major
Subscapular artery
Axillary nerve
Subscapularis
Thoracodorsal artery
Lower subscapular nerve
Latissimus dorsi muscle/tendon

Fig. 7.12 Deep anterior axillary view revealing upper, middle (thoracodorsal), and lower subscapular nerves.



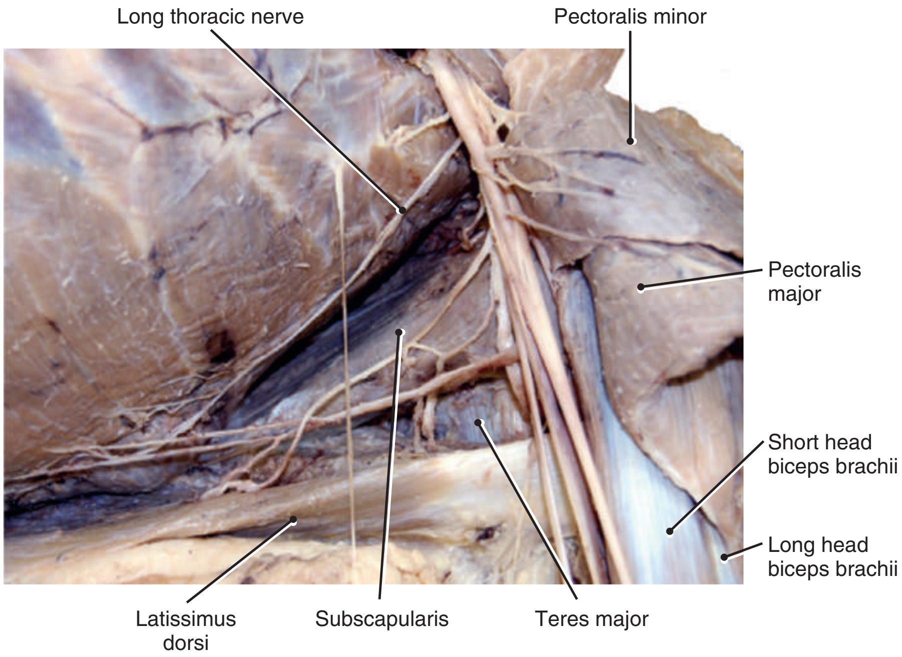
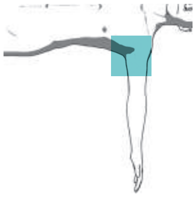

Long thoracic nerve
Pectoralis minor
Pectoralis major
Short head biceps brachii
Long head biceps brachii
Latissimus dorsi
Subscapularis
Teres major

Fig. 7.13 Deep anterior view revealing posterior nerve structures.



DISSECTION **TIP**

ANATOMIC LANDMARKS

- **Scapular circumflex artery:** Arises from the subscapular artery and turns around to enter the gap between the lateral border of the subscapularis and latissimus dorsi muscles alongside the lower subscapular nerve (trace the nerve proximally to its origin from the posterior cord).
- **Lower subscapular nerve:** It runs with the scapular circumflex artery in the gap between the lateral border of the subscapularis and latissimus dorsi muscles.

DISSECTION **TIP**

ANATOMIC LANDMARKS

Upper subscapular nerve: Look deep in the axilla for the nerve that penetrates the subscapularis muscle. It is located deep and medial to the subscapularis muscle.

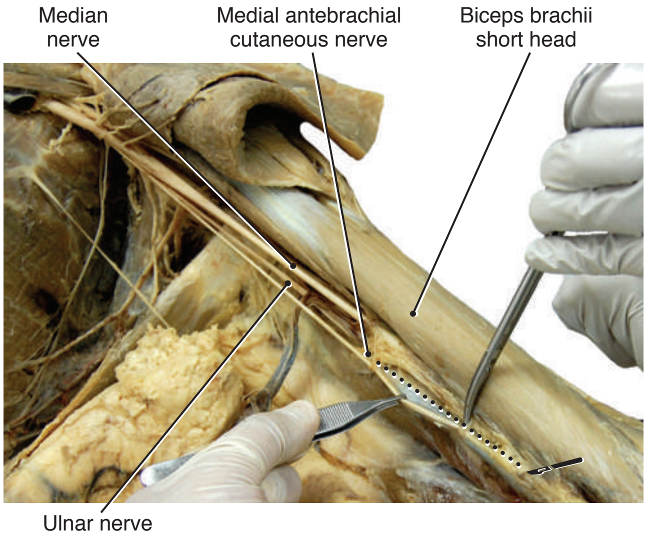
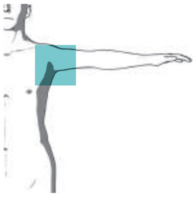
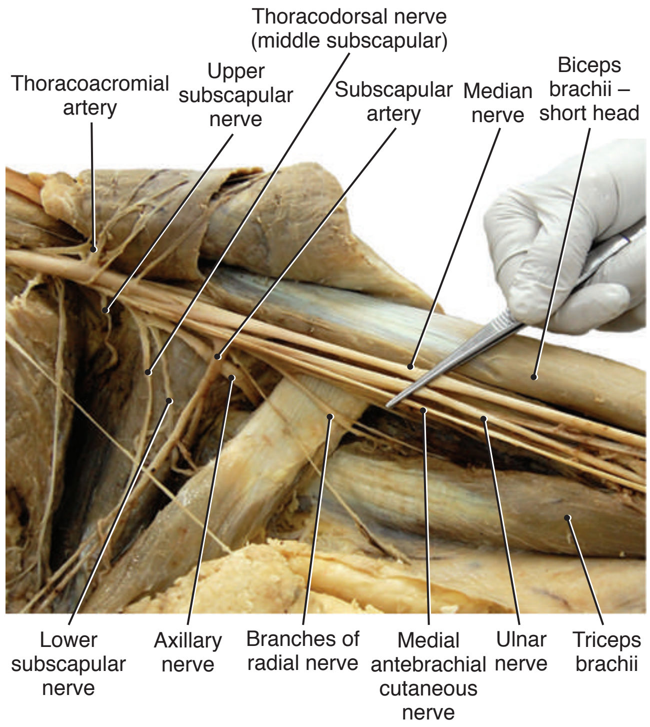

Median nerve
Medial antebrachial cutaneous nerve
Biceps brachii short head
Ulnar nerve

Fig. 7.14 Complete exposure of median, ulnar, and medial antebrachial cutaneous nerves in the arm.



- Continue the dissection by exposing the terminal branches of the brachial plexus in the arm (Figs. 7.14 and 7.15).
- The *axillary* artery changes its name to *brachial* artery as it crosses the lower border of the teres major tendon.
- Identify the first branch of the brachial artery, the *deep* brachial artery running deep to the triceps brachii muscle with the radial nerve.
- Continue the dissection, reflecting the skin over the medial portion of the triceps brachii muscle, and expose all the branches of the radial nerve (Fig. 7.16).
- Reflect the skin medially over the biceps brachii muscle (Figs. 7.16 and 7.17).
- Identify the long and short heads of the biceps brachii.


Thoracodorsal nerve (middle subscapular)
Thoracoacromial artery
Upper subscapular nerve
Subscapular artery
Median nerve
Biceps brachii – short head
Lower subscapular nerve
Axillary nerve
Branches of radial nerve
Medial antebrachial cutaneous nerve
Ulnar nerve
Triceps brachii

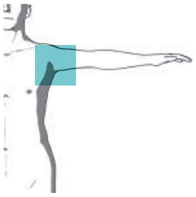


Fig. 7.15 Lower axillary and upper arm view with skin reflected, revealing muscles and nerves.

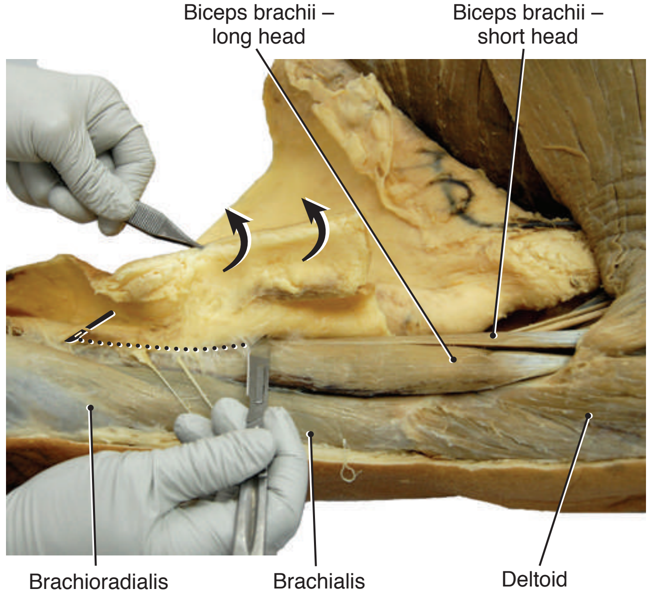

Biceps brachii – long head
Biceps brachii – short head
Brachioradialis
Brachialis
Deltoid

Fig. 7.16 Upper arm view with skin reflected, revealing biceps brachii, brachialis, and deltoid muscles.

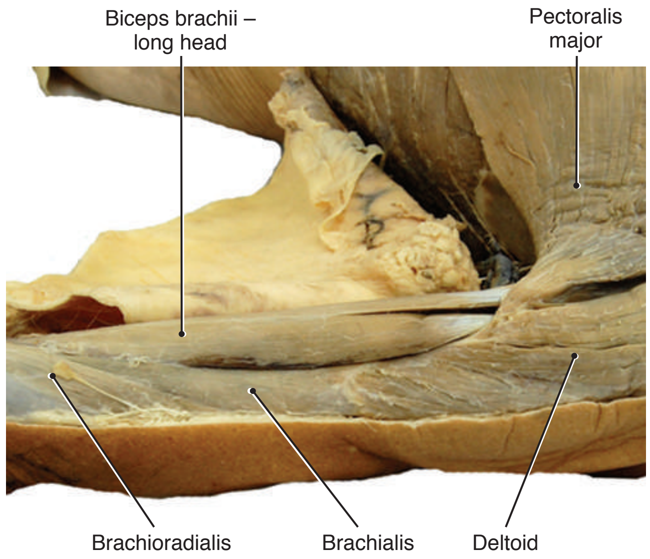

Biceps brachii – long head
Pectoralis major
Brachioradialis
Brachialis
Deltoid

Fig. 7.17 Upper arm view with skin reflected, revealing biceps brachii, brachialis, and deltoid muscles.

DISSECTION **TIP**

If time permits, expose the short head of the biceps brachii from its origin at the coracoid process of the scapula. The tendon of the long head of the biceps brachii lies lateral to the short head. You may expose the tendon of the long head of the biceps brachii muscle from the supraglenoid tubercle, just above the glenoid fossa of the scapula.

- ○ Just inferior to the biceps brachii, identify the brachialis muscle (see Fig. 7.17).
- ○ Identify the coracobrachialis muscle, noting the musculocutaneous nerve passing through the muscle.

ANATOMY **NOTE**

The brachialis muscle is innervated primarily by the musculocutaneous nerve; however, the radial nerve also may contribute to its innervation.

- ○ Reflect the skin over the lateral aspect of the arm inferiorly (Fig. 7.18).
- ○ Identify the posterior cutaneous nerve to the forearm (branch of radial nerve) emerging between the brachialis and triceps brachii muscles (Fig. 7.19).
- ○ Trace the origin of the posterior cutaneous nerve to the forearm by separating the brachialis from the triceps brachii (Fig. 7.20).
- ○ Lift the inferior portion of the deltoid muscle from the humeral surface.
- ○ Reflect the fascia covering the triceps, and expose the lateral head of the triceps brachii muscle (Fig. 7.21).

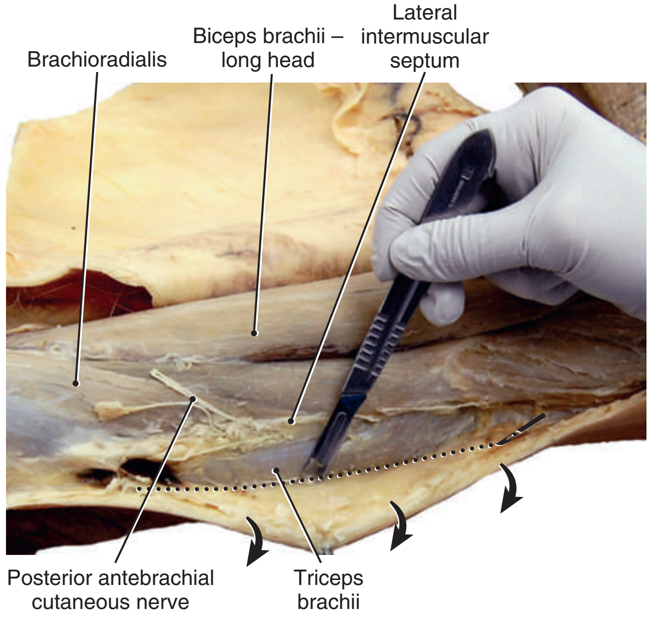

Brachioradialis
Biceps brachii – long head
Lateral intermuscular septum
Posterior antebrachial cutaneous nerve
Triceps brachii

Fig. 7.18 Dissection and reflection of skin over lateral head of triceps brachii, with exposure of posterior antebrachial cutaneous nerve.

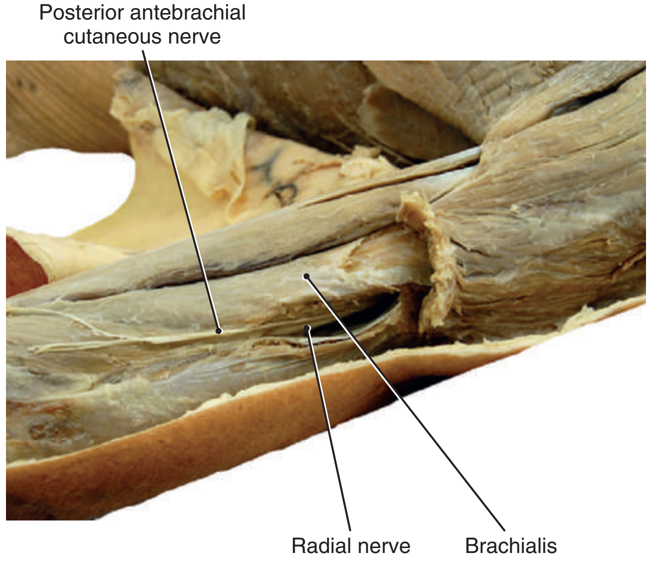

Posterior antebrachial cutaneous nerve
Radial nerve
Brachialis

Fig. 7.20 Reflection of deltoid muscle and exposure of the origin of the posterior antebrachial cutaneous nerve.

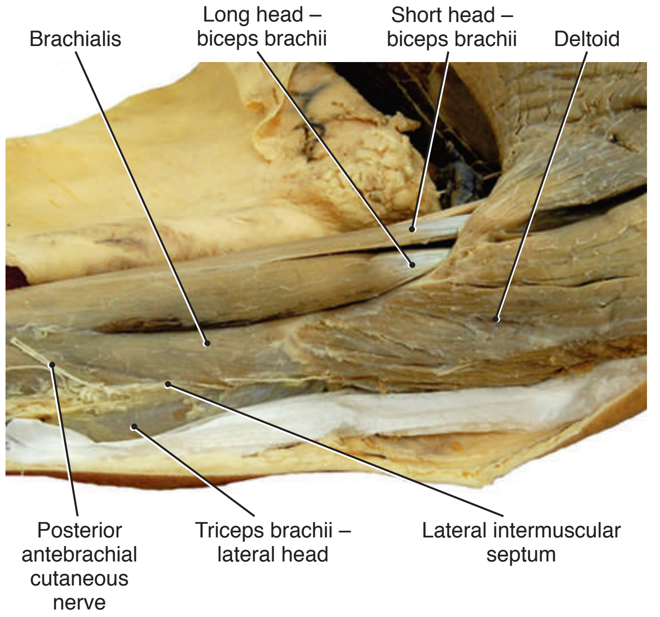

Brachialis
Long head – biceps brachii
Short head – biceps brachii
Deltoid
Posterior antebrachial cutaneous nerve
Triceps brachii – lateral head
Lateral intermuscular septum

Fig. 7.19 Upper arm view with skin reflected, revealing superficial musculature.

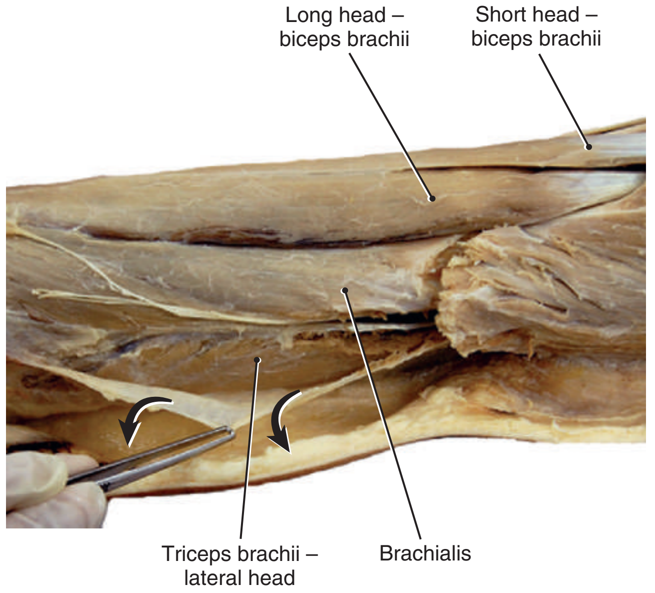

Long head – biceps brachii
Short head – biceps brachii
Triceps brachii – lateral head
Brachialis

Fig. 7.21 Reflection of deltoid and lateral head of triceps brachii, with exposure of posterior cutaneous nerve to the forearm.

- Trace the radial nerve to the radial groove of the humerus between the medial and long heads of the triceps brachii muscle (Fig. 7.22).
- Trace the musculocutaneous nerve as it penetrates the coracobrachialis muscle; then lift the biceps brachii up and observe the course of the musculocutaneous nerve (Fig. 7.23).
- Clean all soft tissues between the biceps brachii and brachialis muscles, and dissect the musculocutaneous nerve to the lateral aspect of the brachium as it emerges to become the lateral antebrachial cutaneous nerve (Fig. 7.24 and Plate 7.2).
- Identify the three heads of the triceps brachii muscle.

ANATOMY **NOTE**

The *lateral* head is the most inferior part of the triceps brachii muscle and is recognizable on the lateral surface of this muscle. The *medial* head arises from the posterior and medial surfaces of the humerus distal to the radial groove. The *long* head arises from the infraglenoid tubercle of the scapula and is located medial and proximal to the radial groove.

DISSECTION **TIP**

If time permits, trace the ascending branch of the deep brachial artery, and look for its anastomosis with the posterior circumflex humeral artery.

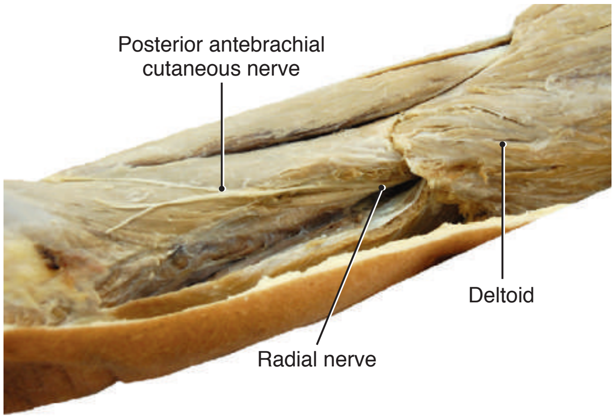
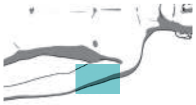

Posterior antebrachial cutaneous nerve
Deltoid
Radial nerve

Fig. 7.22 Reflection of deltoid and lateral head of triceps, with exposure of posterior cutaneous nerve to the forearm and radial nerve.



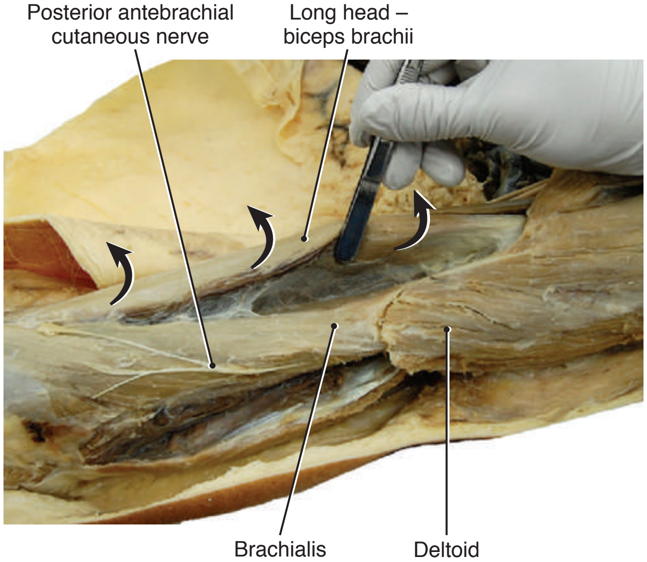
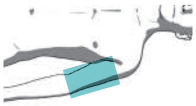

Posterior antebrachial cutaneous nerve
Long head – biceps brachii
Brachialis
Deltoid

Fig. 7.23 Anterior arm view, with traction to biceps brachii revealing musculature and nerve.



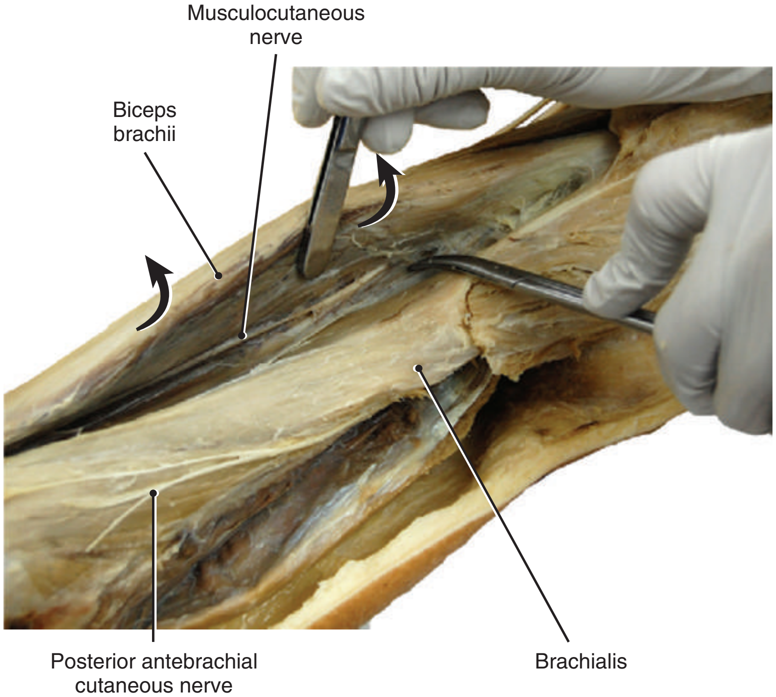
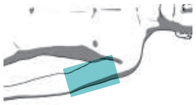
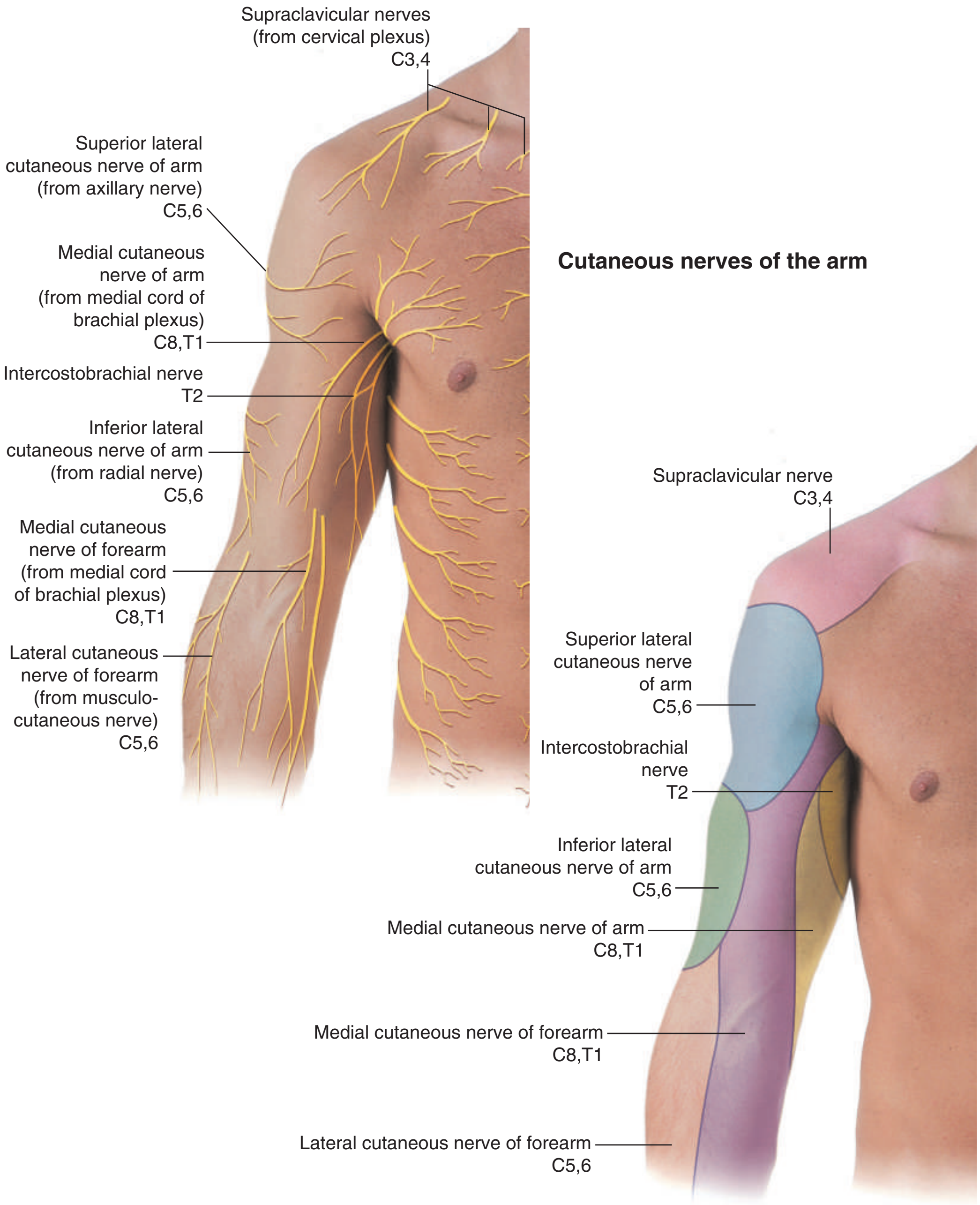

Musculocutaneous nerve
Biceps brachii
Posterior antebrachial cutaneous nerve
Brachialis

Fig. 7.24 Anterior view of the arm with elevation of the biceps brachii, demonstrating the underlying musculocutaneous nerve.





Cutaneous nerves of the arm

Areas of distribution of the cutaneous nerves of the arm

Supraclavicular nerves (from cervical plexus) C3,4
Superior lateral cutaneous nerve of arm (from axillary nerve) C5,6
Medial cutaneous nerve of arm (from medial cord of brachial plexus) C8,T1
Intercostobrachial nerve T2
Inferior lateral cutaneous nerve of arm (from radial nerve) C5,6
Medial cutaneous nerve of forearm (from medial cord of brachial plexus) C8,T1
Lateral cutaneous nerve of forearm (from musculo-cutaneous nerve) C5,6
Supraclavicular nerve C3,4
Superior lateral cutaneous nerve of arm C5,6
Intercostobrachial nerve T2
Inferior lateral cutaneous nerve of arm C5,6
Medial cutaneous nerve of arm C8,T1
Medial cutaneous nerve of forearm C8,T1
Lateral cutaneous nerve of forearm C5,6

Plate 7.2 Cutaneous innervation of the arm.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

Lateral Cords

☐ Musculocutaneous
☐ Lateral pectoral

Medial Cords

☐ Medial pectoral
☐ Medial brachial cutaneous
☐ Medial antebrachial cutaneous
☐ Ulnar nerve

Posterior Cords

☐ Axillary
☐ Upper subscapular
☐ Lower subscapular
☐ Thoracodorsal
☐ Radial

ARTERIES

☐ Axillary
☐ Superior thoracic
☐ Thoracoacromial
☐ Pectoral
☐ Lateral thoracic
☐ Subscapular
☐ Thoracodorsal
☐ Circumflex scapular
☐ Anterior circumflex humeral
☐ Posterior circumflex humeral

VEINS

☐ Axillary
☐ Thoracoepigastric
☐ Cephalic
☐ Brachial
☐ Venae comitantes

LYMPH NODES (IF EVIDENT IN YOUR CADAVER)

☐ Infraclavicular
☐ Apical
☐ Lateral
☐ Central
☐ Subscapular
☐ Pectoral

MUSCLES

☐ Short head of biceps brachii
☐ Long head of biceps brachii
☐ Long head of triceps brachii
☐ Lateral head of triceps brachii
☐ Latissimus dorsi
☐ Pectoralis major
☐ Pectoralis minor
☐ Serratus anterior
☐ Subclavius
☐ Deltoid
☐ Subscapularis
☐ Teres major
☐ Teres minor

FASCIA

☐ Clavipectoral fascia

BONES

☐ Clavicle
☐ Humerus
☐ Scapula

CHAPTER 8 FOREARM (ANTEBRACHIUM)

ATLAS REFERENCES

Netter: 430–440, 463–469
McMinn: 148–153
Gray's Atlas: 424, 430–439, 457–459

BEFORE YOU BEGIN

Palpate the following bony landmarks on the cadaver or on yourself:

- Lateral and medial epicondyles of the humerus
- Styloid process of the radius
- Head, styloid process, olecranon, and shaft of the ulna
- Carpal bones

GETTING STARTED

- ○ **Continue the incision from the lateral side of the shoulder with a vertical incision across the length of the forearm toward the wrist.**
- ○ **Make an encircling incision around the wrist (Fig. 8.1).**
- ○ **Reflect the skin medially from the anterior compartment of the forearm, and expose the antebrachial fascia and the extensor retinaculum (Fig. 8.2).**
- ○ **Identify the posterior cutaneous nerve of the forearm (posterior antebrachial nerve) (see Fig. 8.2).**
- ○ **Identify the lateral cutaneous nerve to the forearm (lateral antebrachial cutaneous nerve), and medial cutaneous nerve to the forearm (medial antebrachial cutaneous nerve) (Fig. 8.3).**

DISSECTION TIP

Preserve as many of the cutaneous nerve branches as possible. Typically, the posterior cutaneous nerve to the forearm emerges between the triceps brachii and brachialis muscles; the lateral cutaneous nerve to the forearm emerges lateral to the bicipital aponeurosis between the biceps brachii and brachioradialis muscles; and the medial cutaneous nerve to the forearm can be traced proximally to the medial cord of the brachial plexus.

CUBITAL FOSSA

- ○ **Reflect the skin over the bicipital aponeurosis, and expose the cubital fossa. The biceps brachii tendon enters the cubital fossa as an aponeurotic expansion.**

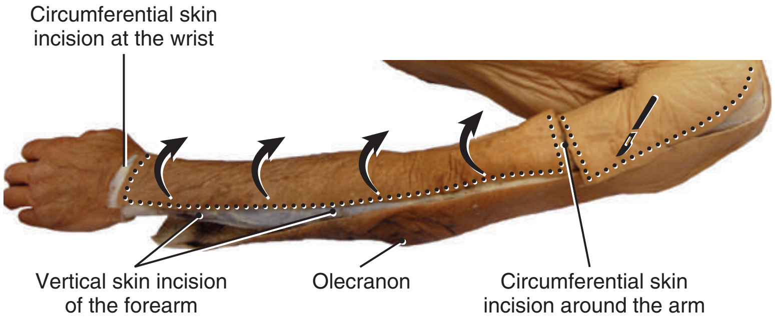

Circumferential skin incision at the wrist
Vertical skin incision of the forearm
Olecranon
Circumferential skin incision around the arm

Fig. 8.1 Skin incisions for arm and forearm dissections.

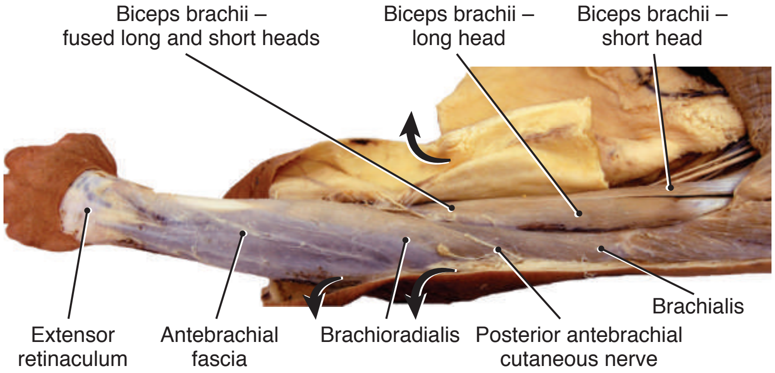

Biceps brachii – fused long and short heads
Biceps brachii – long head
Biceps brachii – short head
Brachialis
Extensor retinaculum
Antebrachial fascia
Brachioradialis
Posterior antebrachial cutaneous nerve

Fig. 8.2 Lateral arm and posterior forearm view with skin reflected, demonstrating superficial structures.

- Remove the deep fascia and the fat on the anterior surface of the cubital fossa, preserving the bicipital aponeurosis.
- Observe how the lateral and medial cutaneous nerves to the forearm relate to the bicipital aponeurosis (Fig. 8.4).
- Lateral to the tendon of the biceps brachii, separate the brachioradialis muscle from the brachialis muscle, and identify the **radial nerve** as it enters the forearm.
- Reflect the bicipital aponeurosis laterally, and identify the **brachial artery**, just deep to the veins of the cubital fossa.
- Retract the brachial artery laterally, and on its medial side, identify the **median nerve**.

LATERAL ARM AND EXTENSOR COMPARTMENT

- Continue the dissection by reflecting the skin over the extensor compartment of the forearm, and identify the distribution of the medial and lateral cutaneous nerves to the forearm (Fig. 8.5).
- Identify the **superficial branch of the radial nerve** just proximal to the lateral side of the wrist (Fig. 8.6).
- With a pair of scissors, make a small incision into the antebrachial fascia (deep fascia) near the lateral epicondyle (Fig. 8.7).
- Reflect the antebrachial fascia, and expose the underlying musculature of the extensor compartment of the forearm (Figs. 8.8 to 8.10).
- Remove all remnants of deep fascia covering the extensor surface.

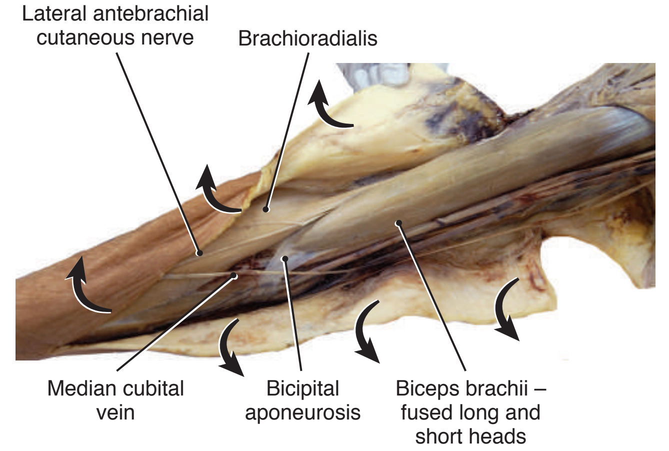

Lateral antebrachial cutaneous nerve
Brachioradialis
Median cubital vein
Bicipital aponeurosis
Biceps brachii – fused long and short heads

Fig. 8.3 Lateral arm view with skin reflected, demonstrating superficial structures.

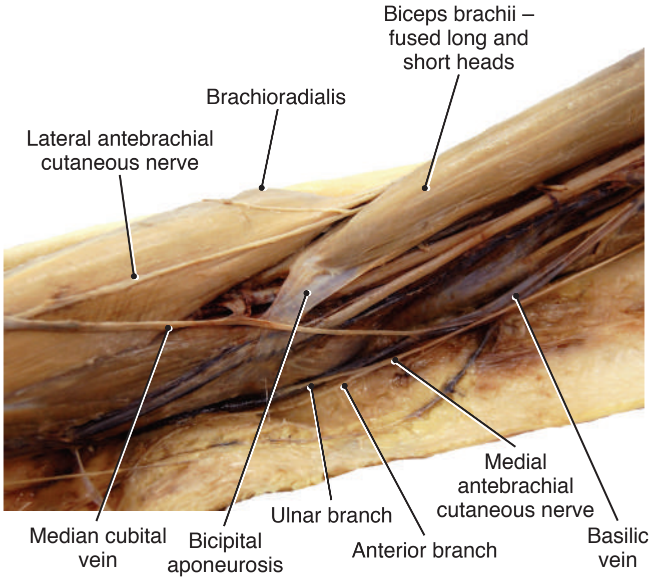

Biceps brachii – fused long and short heads
Brachioradialis
Lateral antebrachial cutaneous nerve
Medial antebrachial cutaneous nerve
Ulnar branch
Basilic vein
Median cubital vein
Bicipital aponeurosis
Anterior branch

Fig. 8.4 Cubital region with skin reflected, showing superficial structures.

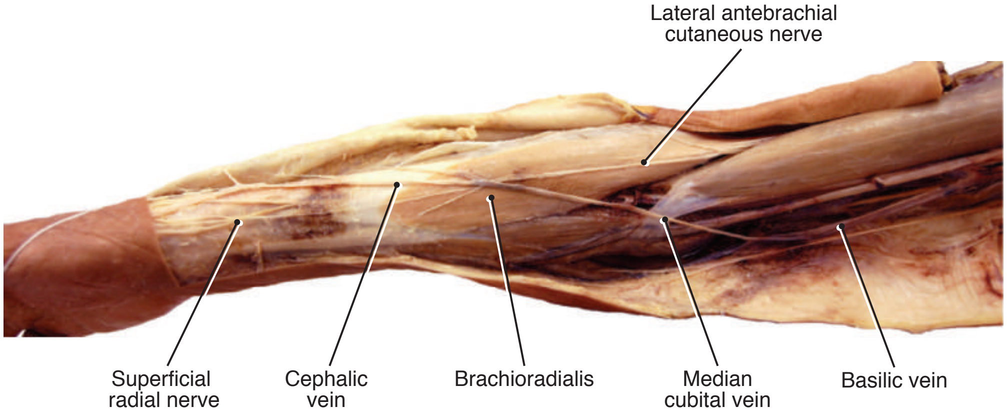

Lateral antebrachial cutaneous nerve
Superficial radial nerve
Cephalic vein
Brachioradialis
Median cubital vein
Basilic vein

Fig. 8.5 Anterior arm and forearm view with skin reflected, demonstrating superficial structures.

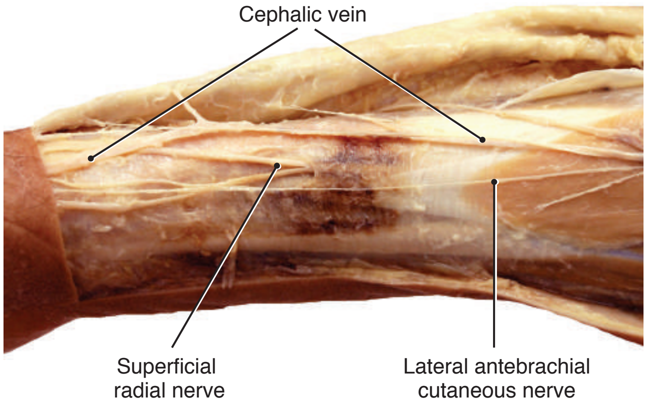

Cephalic vein
Superficial radial nerve
Lateral antebrachial cutaneous nerve

Fig. 8.6 Cubital fossa view with skin reflected, showing superficial structures.

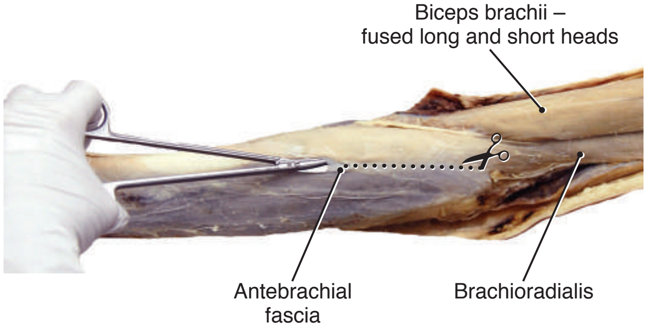

Biceps brachii – fused long and short heads
Antebrachial fascia
Brachioradialis

Fig. 8.7 Anterior forearm and cubital fossa view with skin removed, demonstrating fascia.

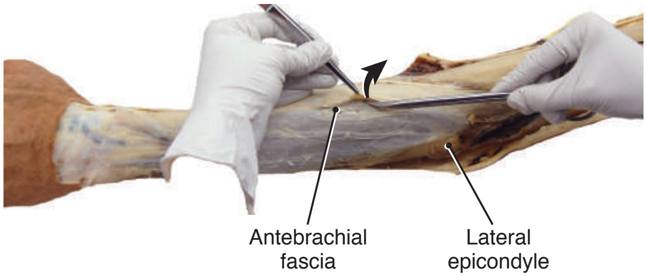

Antebrachial fascia
Lateral epicondyle

Fig. 8.8 Posterior forearm with skin removed, showing fascia.

DISSECTION TIP

Take special care when the deep fascia is removed. In the majority of cases, the deep fascia adheres tightly to the muscles of the extensor compartment (Fig. 8.11). To identify the tendinous insertions of the muscles of the extensor compartment, the skin over the dorsum of the hand also is removed.

- Make a vertical incision at the midpoint of the wrist to the midline of the 3rd digit (Fig. 8.12).

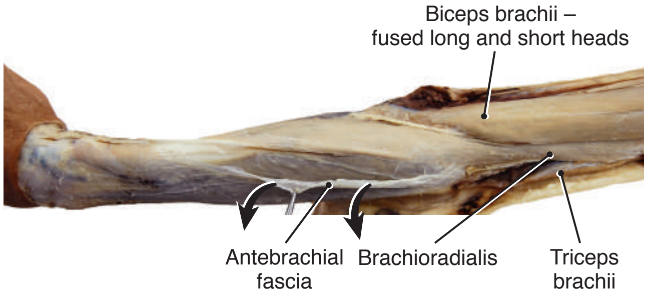

Biceps brachii – fused long and short heads
Antebrachial fascia
Brachioradialis
Triceps brachii

Fig. 8.9 Posterolateral forearm view with skin removed, demonstrating fascia and superficial structures.

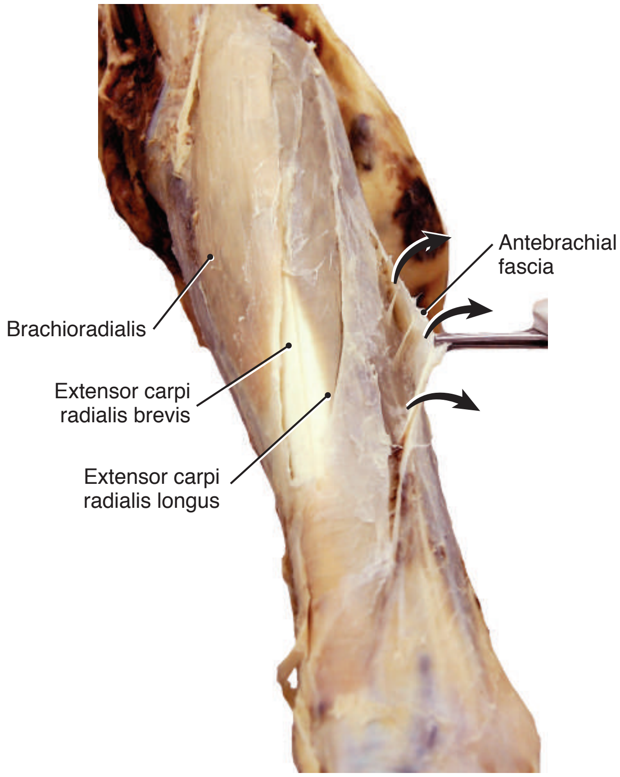

Antebrachial fascia
Brachioradialis
Extensor carpi radialis brevis
Extensor carpi radialis longus

Fig. 8.10 Posterior forearm view with skin reflected, showing fascia and superficial structures.

- With a pair of forceps, lift the skin over the dorsum of the hand, and detach it from the underlying dermis (Fig. 8.13).
- Reflect the skin laterally without cutting any of the nerves and tributaries of the **dorsal venous arch** (Figs. 8.14 and 8.15).
- With a fine pair of scissors, expose the dorsal venous arch (Fig. 8.16).
- As the subcutaneous tissue is removed, pay special attention to identifying the cutaneous nerves running alongside the dorsal venous arch (Fig. 8.17).

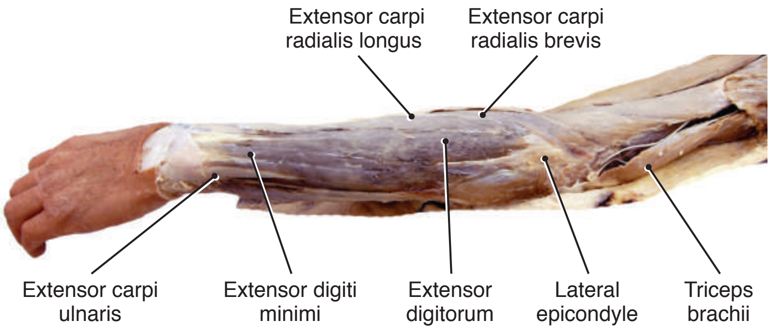

Extensor carpi radialis longus
Extensor carpi radialis brevis
Extensor carpi ulnaris
Extensor digiti minimi
Extensor digitorum
Lateral epicondyle
Triceps brachii

Fig. 8.11 Posterior arm and forearm view with skin removed, demonstrating fascia.

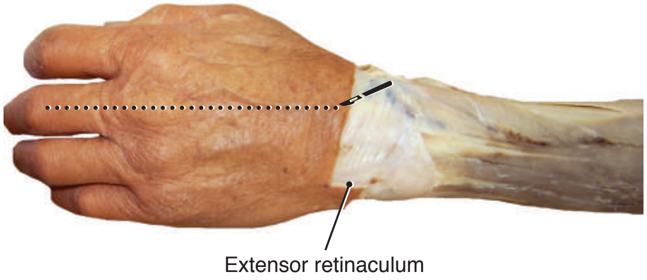

Extensor retinaculum

Fig. 8.12 Posterior wrist view with skin removed, showing extensor retinaculum.

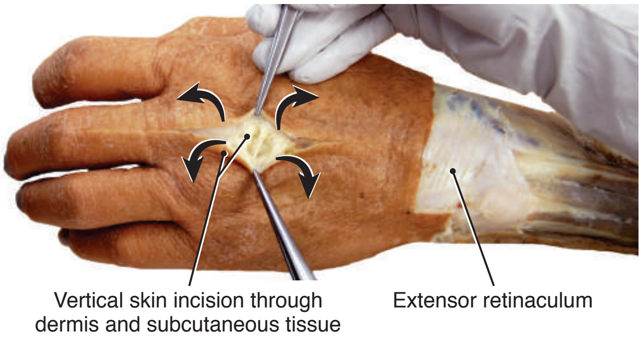

Vertical skin incision through dermis and subcutaneous tissue
Extensor retinaculum

Fig. 8.13 Posterior wrist view with skin removed, demonstrating extensor retinaculum.

DISSECTION TIP

Exposing the dorsal venous arch and the cutaneous nerves on the dorsum of the hand can take some time (see Fig. 8.17). If time does not permit, skip this step and remove the subcutaneous tissue, dorsal venous arch, and cutaneous branches en bloc.

- Continue the reflection of the skin over the 3rd digit (Fig. 8.18).
- Identify the *extensor retinaculum*, a thick fibrous band of the antebrachial fascia that holds the tendons of the extensor compartment in place (Fig. 8.19).

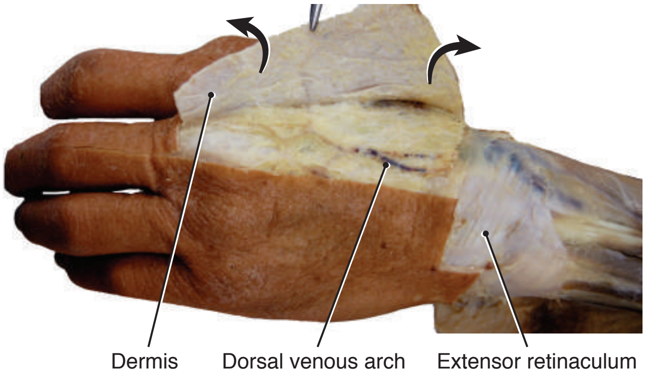

Dermis
Dorsal venous arch
Extensor retinaculum

Fig. 8.14 Posterior hand view after skin reflection.

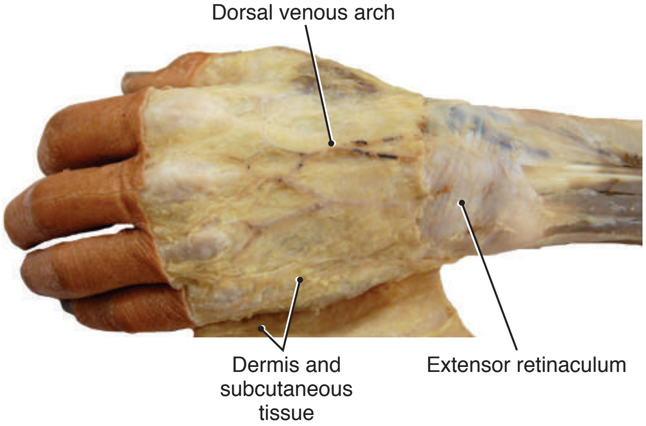

Dorsal venous arch
Dermis and subcutaneous tissue
Extensor retinaculum

Fig. 8.15 Posterior hand and wrist view with skin reflected, demonstrating superficial structures.

- Place a probe or scissors underneath the extensor retinaculum (Fig. 8.20), and release it from the underlying tendons.
- Make a vertical incision, and retract the retinaculum laterally to expose the tendons of the extensor compartment (Fig. 8.21).
- Identify the extensor digitorum muscle (see Fig. 8.21).
- Lift its tendons and clean away its tendinous sheath (Fig. 8.22).

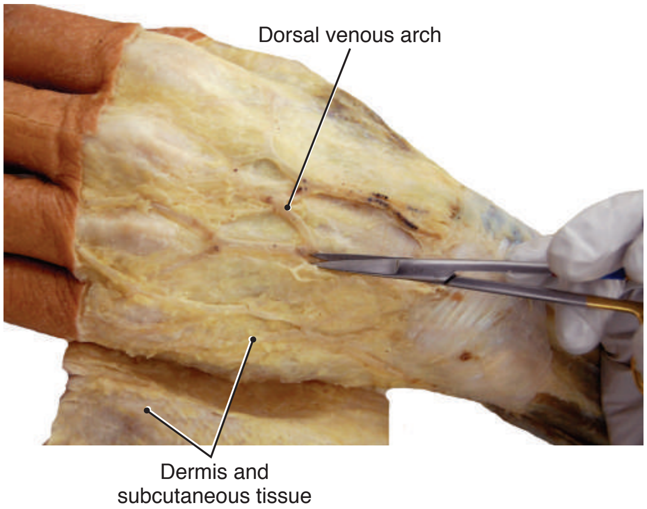

Dorsal venous arch
Dermis and subcutaneous tissue

Fig. 8.16 Posterior hand and wrist view with skin reflected, showing venous arch.

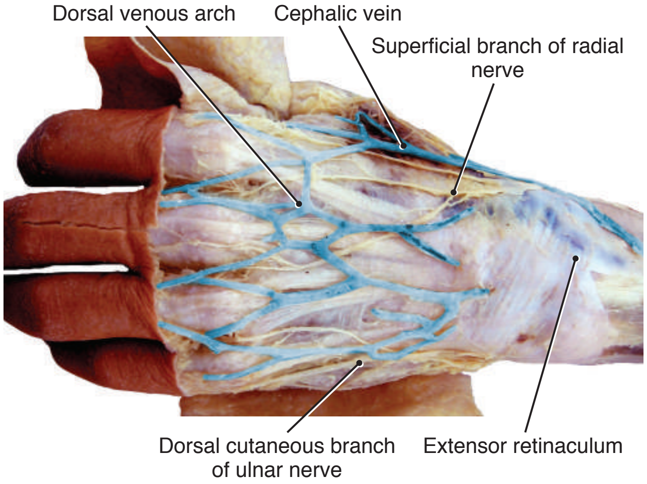

Dorsal venous arch
Cephalic vein
Superficial branch of radial nerve
Dorsal cutaneous branch of ulnar nerve
Extensor retinaculum

Fig. 8.17 Posterior hand and wrist view with skin reflected, highlighting superficial nerves and veins.

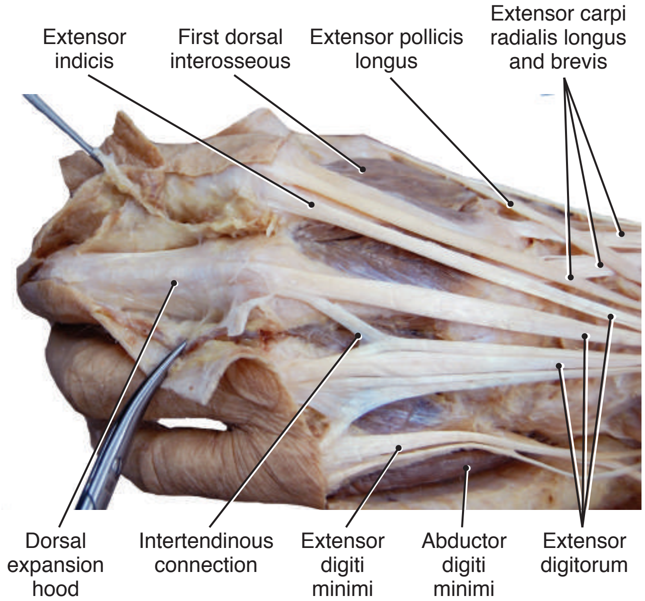

Extensor indicis
First dorsal interosseous
Extensor pollicis longus
Extensor carpi radialis longus and brevis
Dorsal expansion hood
Intertendinous connection
Extensor digiti minimi
Abductor digiti minimi
Extensor digitorum

Fig. 8.18 Posterior hand and wrist with skin reflected, exposing extensor tendons.

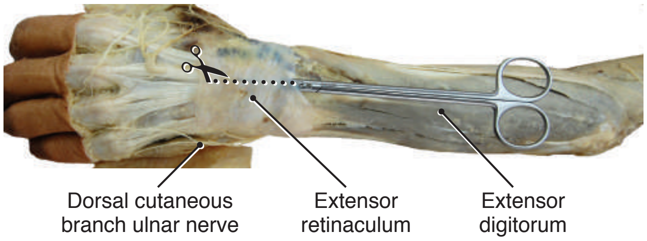

Dorsal cutaneous branch ulnar nerve
Extensor retinaculum
Extensor digitorum

Fig. 8.19 Posterior hand and forearm with skin removed, demonstrating superficial structures.

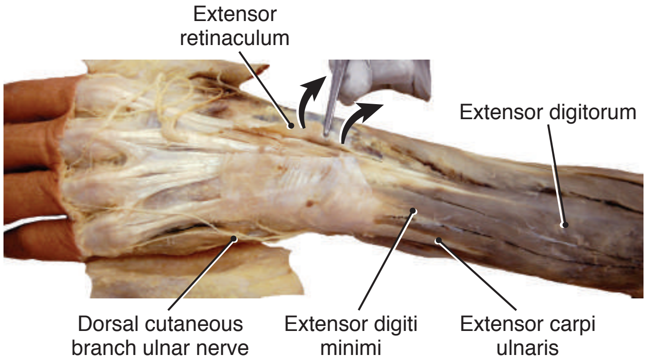

Extensor retinaculum
Extensor digitorum
Dorsal cutaneous branch ulnar nerve
Extensor digiti minimi
Extensor carpi ulnaris

Fig. 8.20 Posterior hand and forearm view with skin removed, showing superficial structures.

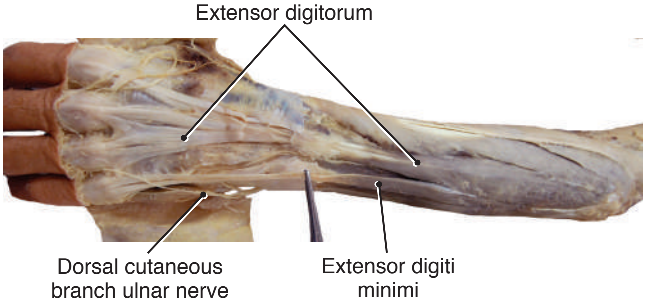

Extensor digitorum
Dorsal cutaneous branch ulnar nerve
Extensor digiti minimi

Fig. 8.21 Posterior hand and forearm with skin removed, highlighting superficial structures.

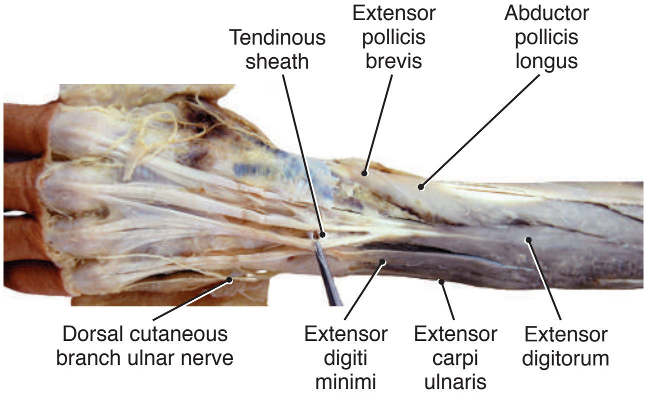

Tendinous sheath
Extensor pollicis brevis
Abductor pollicis longus
Dorsal cutaneous branch ulnar nerve
Extensor digiti minimi
Extensor carpi ulnaris
Extensor digitorum

Fig. 8.22 Posterior hand and forearm with skin reflected, demonstrating musculotendinous structures.

- On the radial side of the extensor digitorum muscle, identify the tendons of the **abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus muscles** (see Fig. 8.22).
- On its ulnar side, identify the **extensor digiti minimi muscle**, which is seen traveling to the 5th digit. In the majority of specimens, this muscle belly is fused with the extensor digitorum muscle (Fig. 8.23).

DISSECTION **TIP**

In the majority of specimens, the muscle bellies of the abductor pollicis longus and extensor pollicis brevis muscles are fused. Use your scissors to separate them (see Fig. 8.23).

- Lift the extensor digitorum muscle, and identify the **extensor indicis muscle** deep to it (Fig. 8.24). The extensor indicis typically runs along the ulnar side of the tendon from the extensor digitorum to the 2nd digit.
- At the distal third of the forearm, lift the extensor pollicis longus and extensor pollicis brevis muscles, and underneath them, identify the **extensor carpi radialis longus and brevis muscles** (Figs. 8.25 and 8.26).
- Medial to the extensor carpi radialis brevis muscle, palpate Lister's (dorsal radial) tubercle (Fig. 8.27).
- On the ulnar side of the extensor digitorum, identify the **extensor digiti minimi** and the **extensor carpi ulnaris muscles** (Fig. 8.28).

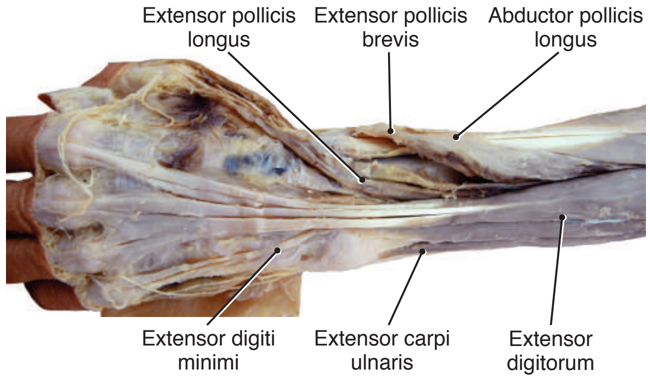

Extensor pollicis longus
Extensor pollicis brevis
Abductor pollicis longus
Extensor digiti minimi
Extensor carpi ulnaris
Extensor digitorum

Fig. 8.23 Posterior hand and forearm with skin reflected, highlighting musculotendinous structures.

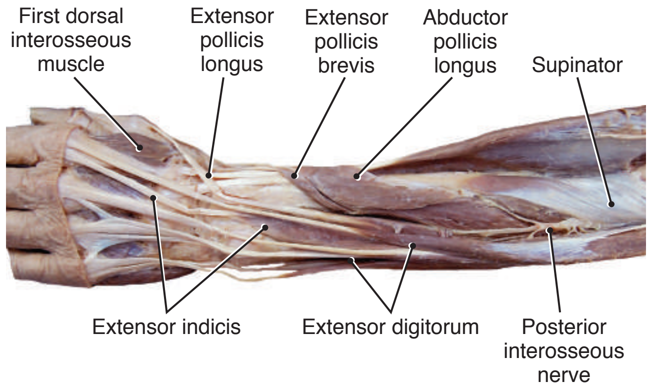

First dorsal interosseous muscle
Extensor pollicis longus
Extensor pollicis brevis
Abductor pollicis longus
Supinator
Extensor indicis
Extensor digitorum
Posterior interosseous nerve

Fig. 8.24 Posterior forearm view with brachioradialis muscle reflected, demonstrating muscles and tendons.

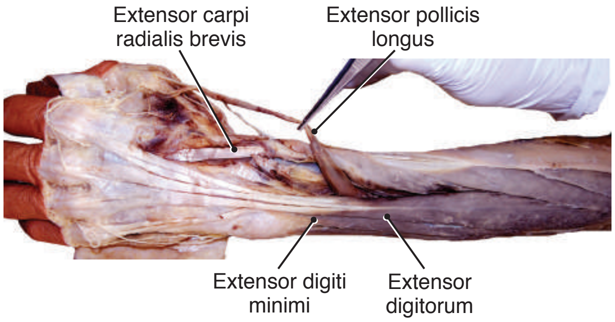

Extensor carpi radialis brevis
Extensor pollicis longus
Extensor digiti minimi
Extensor digitorum

Fig. 8.25 Posterior hand and forearm view with skin reflected.

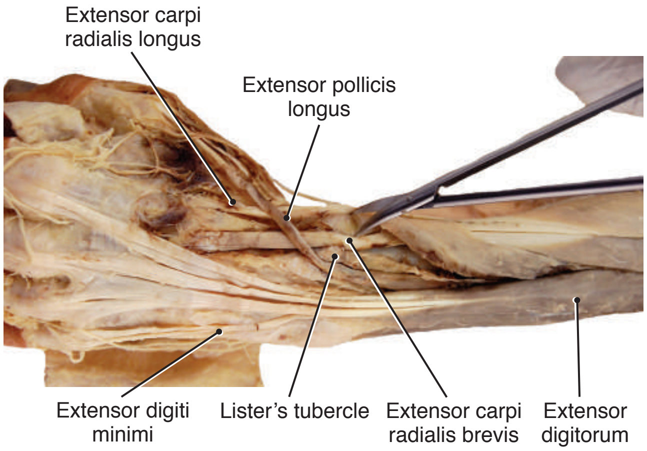

Extensor carpi radialis longus
Extensor pollicis longus
Extensor digiti minimi
Lister's tubercle
Extensor carpi radialis brevis
Extensor digitorum

Fig. 8.26 Posterior hand and forearm with skin reflected.

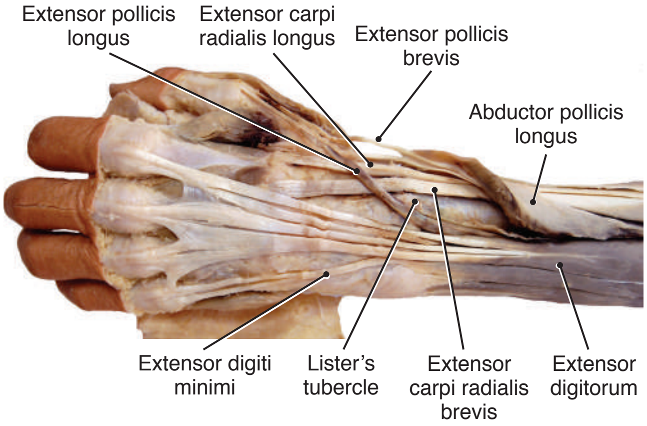

Extensor pollicis longus
Extensor carpi radialis longus
Extensor pollicis brevis
Abductor pollicis longus
Extensor digiti minimi
Lister's tubercle
Extensor carpi radialis brevis
Extensor digitorum

Fig. 8.27 Posterior hand and forearm with skin reflected.

- Follow the extensor carpi ulnaris to the wrist. Cut the extensor retinaculum (Fig. 8.29), and release the tendons underneath it (Fig. 8.30).
- Retract the extensor carpi ulnaris muscle, and separate it from the adjacent extensor digiti minimi muscle (Figs. 8.31 and 8.32).
- On the radial aspect of the proximal part of the forearm, identify and separate the **brachioradialis, extensor carpi radialis longus, extensor carpi radialis brevis, and extensor digitorum muscles** (Fig. 8.33).
- Lift the brachioradialis from the underlying extensor carpi radialis longus muscle. Use a probe or scissors to complete the separation of these two muscles (Figs. 8.34 and 8.35).
- Reflect or lift the brachioradialis muscle anteriorly, and identify the **radial nerve** (Fig. 8.36). Lift the brachioradialis muscle to allow maximum exposure of the radial nerve.
- Clean the radial nerve and identify its division into **superficial and deep branches.** The superficial branch runs beneath the brachioradialis to reach the dorsum of the hand. The deep branch of the radial nerve runs through the **supinator muscle.**
- With a pair of scissors, cut between the fibers of the extensor carpi radialis brevis and extensor digitorum muscles, and expose the supinator muscle lying underneath (Fig. 8.37).

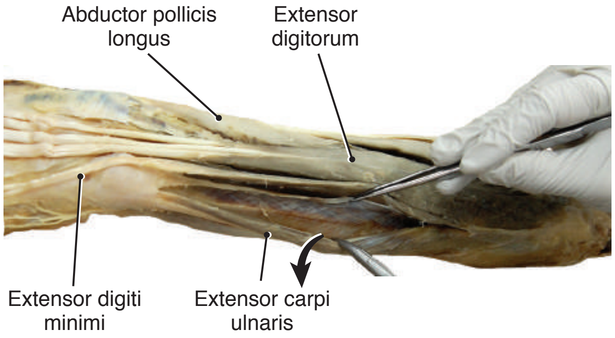

Abductor pollicis longus
Extensor digitorum
Extensor digiti minimi
Extensor carpi ulnaris

Fig. 8.28 Anteromedial forearm view, demonstrating ulnar artery and nerves.

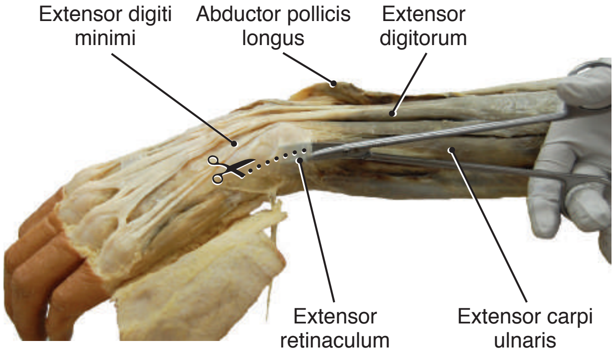

Extensor digiti minimi
Abductor pollicis longus
Extensor digitorum
Extensor retinaculum
Extensor carpi ulnaris

Fig. 8.29 Medial posterior view of wrist, demonstrating superficial structures.

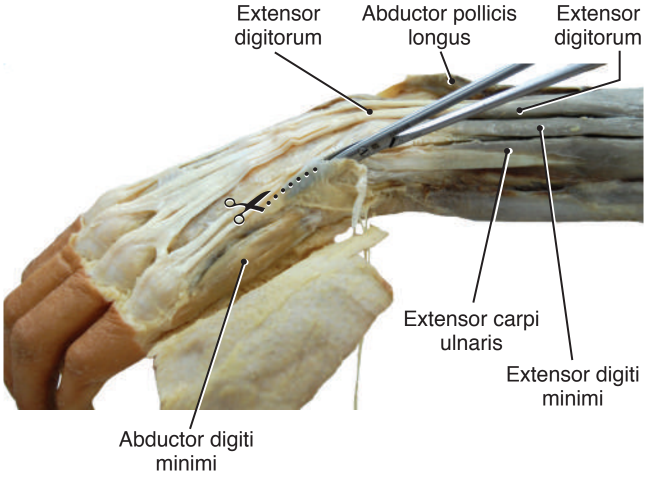

Extensor digitorum
Abductor pollicis longus
Extensor digitorum
Extensor carpi ulnaris
Extensor digiti minimi
Abductor digiti minimi

Fig. 8.30 Medial posterior view of wrist, demonstrating superficial structures.

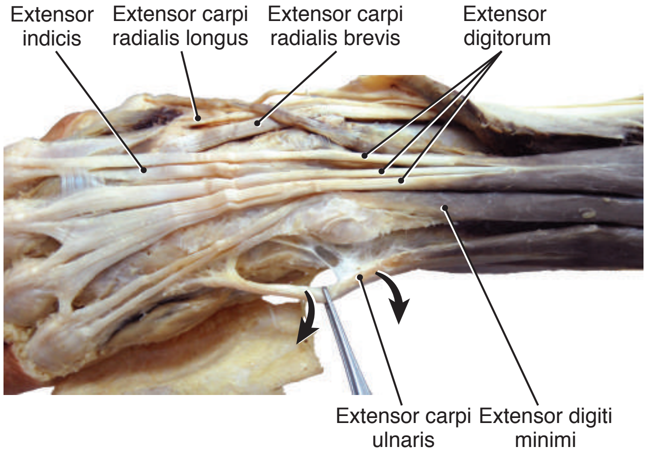

Extensor indicis
Extensor carpi radialis longus
Extensor carpi radialis brevis
Extensor digitorum
Extensor carpi ulnaris
Extensor digiti minimi

Fig. 8.31 Posteromedial view of wrist, showing muscle tendons.

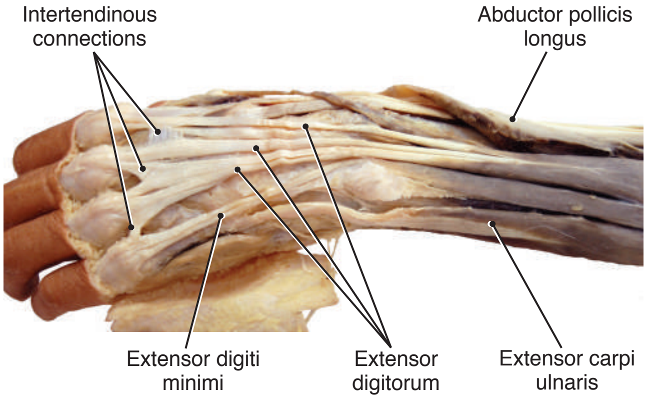

Intertendinous connections
Abductor pollicis longus
Extensor digiti minimi
Extensor digitorum
Extensor carpi ulnaris

Fig. 8.32 Posteromedial view of wrist, exposing muscle tendons.

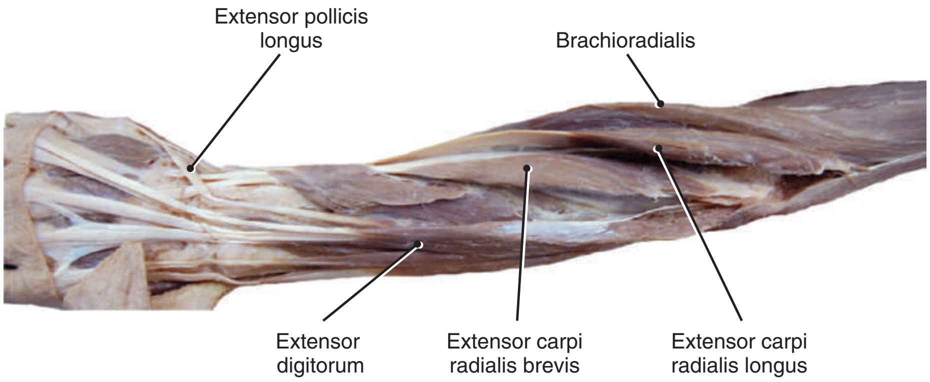

Extensor pollicis longus
Brachioradialis
Extensor digitorum
Extensor carpi radialis brevis
Extensor carpi radialis longus

Fig. 8.33 Posterior view of upper forearm, highlighting musculature.

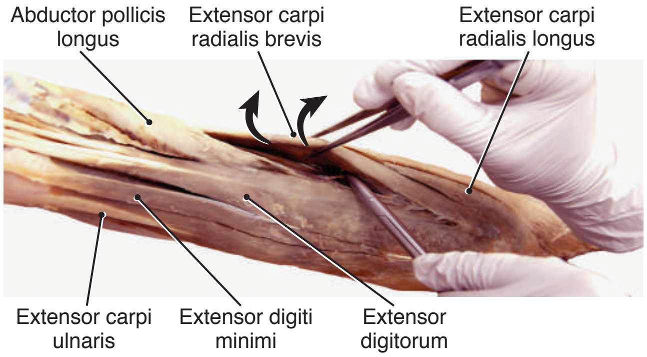

Abductor pollicis longus
Extensor carpi radialis brevis
Extensor carpi radialis longus
Extensor carpi ulnaris
Extensor digiti minimi
Extensor digitorum

Fig. 8.34 Posterior upper forearm view, demonstrating musculature.

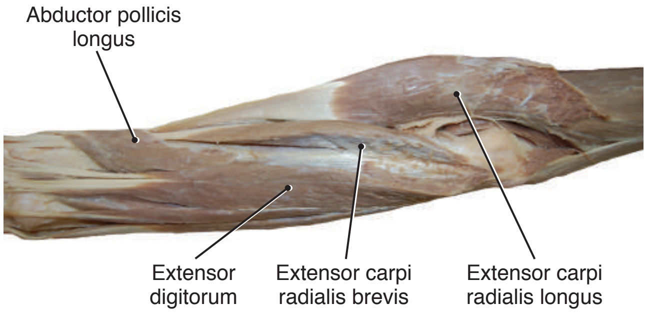

Abductor pollicis longus
Extensor digitorum
Extensor carpi radialis brevis
Extensor carpi radialis longus

Fig. 8.36 Posterior view of forearm, demonstrating musculature.

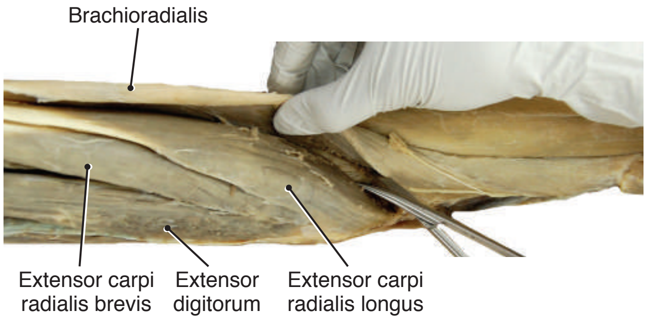

Brachioradialis
Extensor carpi radialis brevis
Extensor digitorum
Extensor carpi radialis longus

Fig. 8.35 Posterior upper forearm view, showing musculature.

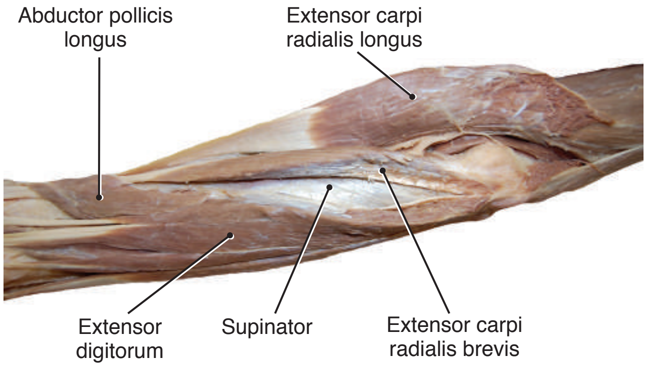

Abductor pollicis longus
Extensor carpi radialis longus
Extensor digitorum
Supinator
Extensor carpi radialis brevis

Fig. 8.37 Posterior view of forearm, showing musculature.

- Reflect the extensor digitorum away from the supinator muscle to expose the supinator's borders (Fig. 8.38).
- At the inferior border of the supinator, trace and expose the **deep radial nerve** (Fig. 8.39, Plate 8.1). With a scalpel, make an **incision in the supinator** where the deep branch of the radial nerve first enters it (Fig. 8.40).
- Reflect the supinator, and expose the deep radial nerve (Fig. 8.41, Plate 8.2).
- Make an incision on the posterior border of the ulna, and detach the extensor carpi ulnaris muscle. Look for the emergence of the **posterior interosseous artery** running parallel to the deep branch of the radial nerve between the radius and the ulna.

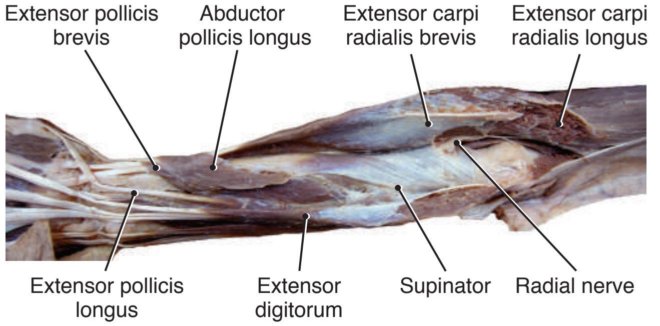

Extensor pollicis brevis
Abductor pollicis longus
Extensor carpi radialis brevis
Extensor carpi radialis longus
Extensor pollicis longus
Extensor digitorum
Supinator
Radial nerve

Fig. 8.38 Posterior view with brachioradialis muscle cut, demonstrating radial nerve and supinator muscle.

DISSECTION **TIP**

The recurrent interosseous artery can be found between the anconeus and supinator muscles. Remove the anconeus, which travels from the lateral epicondyle to the lateral aspect of the olecranon. Just beneath it, on the anterior surface of the supinator, identify the recurrent interosseous artery. This artery is usually small and often is cut during routine dissection.

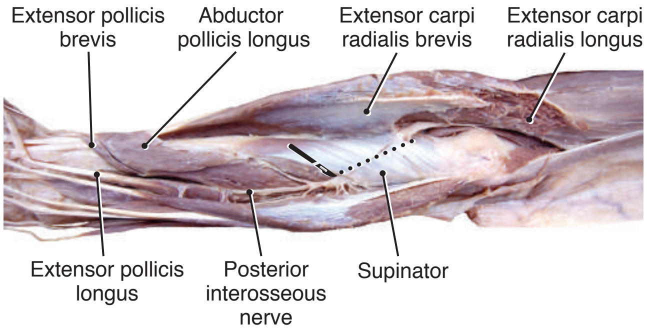

Extensor pollicis brevis
Abductor pollicis longus
Extensor carpi radialis brevis
Extensor carpi radialis longus
Extensor pollicis longus
Posterior interosseous nerve
Supinator

Fig. 8.40 Posterior view with brachioradialis cut, demonstrating supinator muscle.

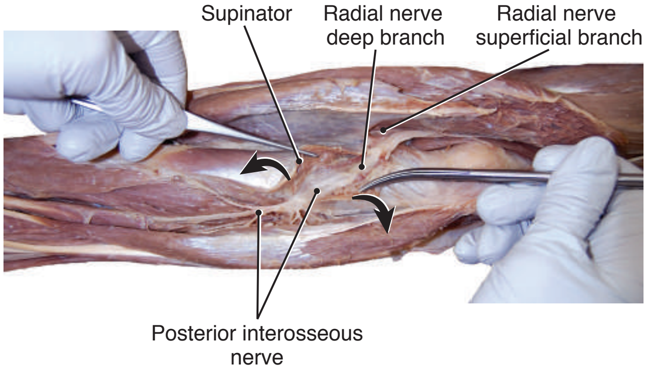

Supinator
Radial nerve deep branch
Radial nerve superficial branch
Posterior interosseous nerve

Fig. 8.41 Posterior forearm view with brachioradialis cut, demonstrating radial nerve branches, supinator muscle, and posterior interosseous nerve.

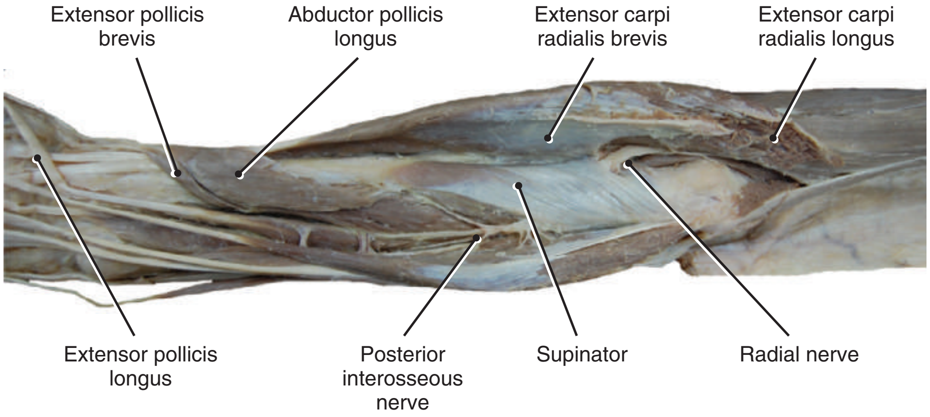

Extensor pollicis brevis
Abductor pollicis longus
Extensor carpi radialis brevis
Extensor carpi radialis longus
Extensor pollicis longus
Posterior interosseous nerve
Supinator
Radial nerve

Fig. 8.39 Posterior view with brachioradialis muscle cut, showing radial nerve and supinator muscle.

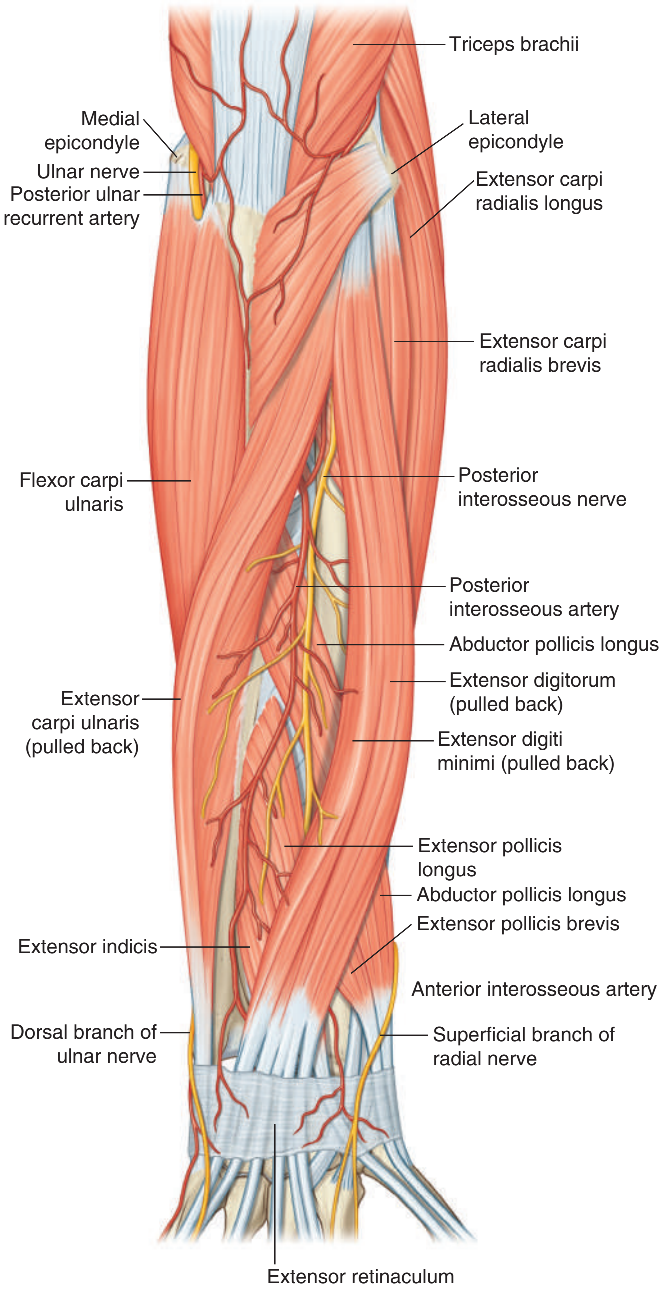

Triceps brachii
Medial epicondyle
Lateral epicondyle
Ulnar nerve
Posterior ulnar recurrent artery
Extensor carpi radialis longus
Extensor carpi radialis brevis
Flexor carpi ulnaris
Posterior interosseous nerve
Posterior interosseous artery
Abductor pollicis longus
Extensor digitorum (pulled back)
Extensor carpi ulnaris (pulled back)
Extensor digiti minimi (pulled back)
Extensor pollicis longus
Abductor pollicis longus
Extensor pollicis brevis
Extensor indicis
Anterior interosseous artery
Dorsal branch of ulnar nerve
Superficial branch of radial nerve
Extensor retinaculum

Plate 8.1 Arteries and nerves of the extensor compartment of the forearm.

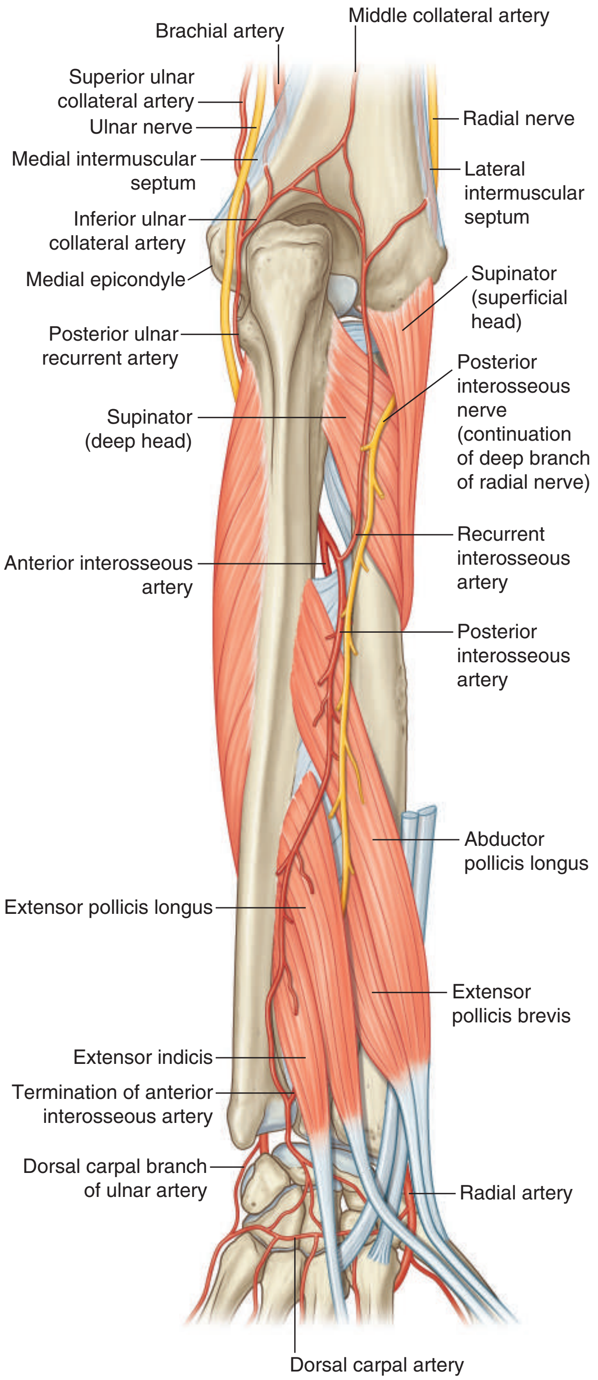

Brachial artery
Middle collateral artery
Superior ulnar collateral artery
Ulnar nerve
Radial nerve
Medial intermuscular septum
Lateral intermuscular septum
Inferior ulnar collateral artery
Medial epicondyle
Supinator (superficial head)
Posterior ulnar recurrent artery
Posterior interosseous nerve (continuation of deep branch of radial nerve)
Supinator (deep head)
Recurrent interosseous artery
Anterior interosseous artery
Posterior interosseous artery
Abductor pollicis longus
Extensor pollicis longus
Extensor pollicis brevis
Extensor indicis
Termination of anterior interosseous artery
Dorsal carpal branch of ulnar artery
Radial artery
Dorsal carpal artery

Plate 8.2 Arteries and nerves of the extensor compartment of the forearm (deeper dissection).

FLEXOR COMPARTMENT

- After completion of the dissection of the extensor compartment, rotate the upper limb and visualize the flexor compartment (Fig. 8.42).
- Make a vertical incision across the length of the forearm toward the wrist. Make an encircling incision around the cubital fossa and the wrist (see Fig. 8.42).
- Reflect the skin medially and laterally from the flexor compartment, and expose the antebrachial fascia and the flexor retinaculum (Fig. 8.43). Continue the vertical midline incision toward the 3rd digit. Chapter 9 details the dissection of the hand.
- Identify the venous network in the flexor compartment and in the cubital fossa. Trace the tributaries of the basilic vein.
- Identify the **median cubital vein** connecting the **basilic** and **cephalic veins** (Fig. 8.44).
- Once you identify the cephalic vein, trace it proximally to the arm. Lateral to the cephalic vein, identify the **lateral cutaneous nerve to the forearm, or lateral antebrachial cutaneous nerve.**
- This nerve is the cutaneous branch of **musculocutaneous nerve** and supplies the lateral aspect of the forearm (see Fig. 8.44).

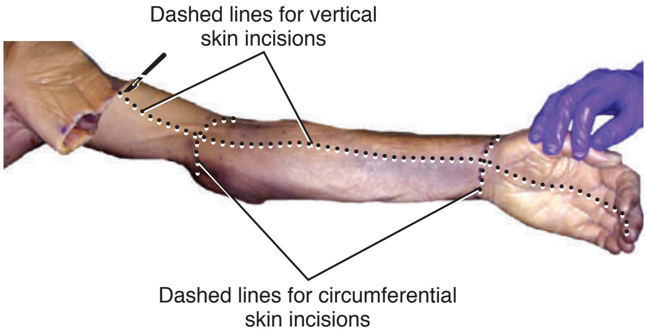

Dashed lines for vertical skin incisions
Dashed lines for circumferential skin incisions

Fig. 8.42 Anterior view of arm, forearm, and hand, with dashed lines for incisions.

- Notice the thick, flat connective tissue aponeurosis of the biceps brachii muscle, the *bicipital aponeurosis.*
- An easy way to identify the muscles of the forearm is to expose them from the wrist toward the cubital fossa.
- At the wrist, the tendons of each muscle are fairly evident and require minimal dissection.
- The following three muscles occupy the superficial layer of the muscles of the flexor compartment.
    - On the radial side of the forearm, identify the **flexor carpi radialis muscle** (Fig. 8.45). The flexor carpi radialis attaches to the second metacarpal bone, and some of its fibers may radiate to the adjacent 3rd metacarpal.
    - Medial to the flexor carpi radialis, note the **palmaris longus** muscle inserting into the palmar aponeurosis.
    - On the ulnar side of the forearm, identify the **flexor carpi ulnaris muscle.**

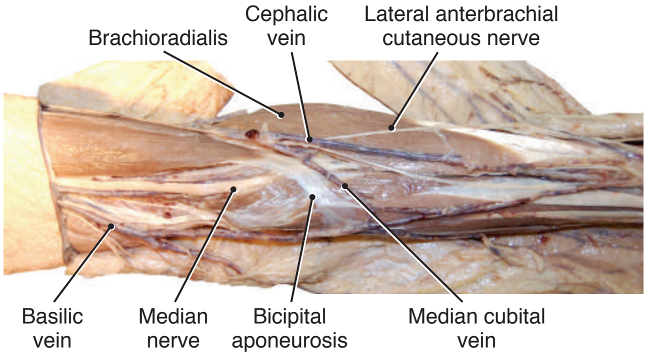
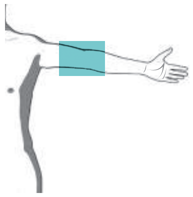

Brachioradialis
Cephalic vein
Lateral anterbrachial cutaneous nerve
Basilic vein
Median nerve
Bicipital aponeurosis
Median cubital vein

Fig. 8.44 Anterior cubital fossa demonstrating superficial structures.



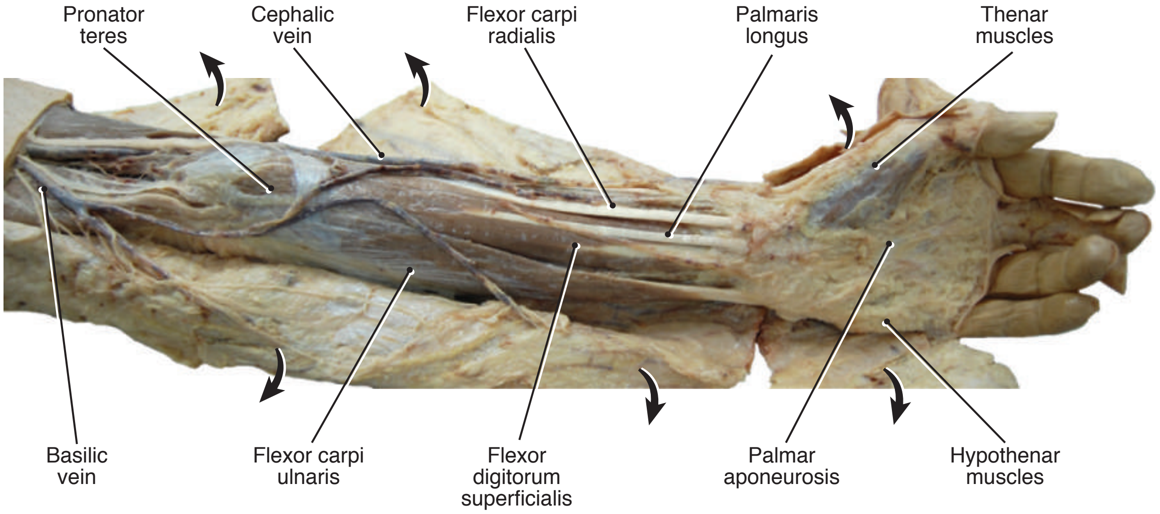

Pronator teres
Cephalic vein
Flexor carpi radialis
Palmaris longus
Thenar muscles
Basilic vein
Flexor carpi ulnaris
Flexor digitorum superficialis
Palmar aponeurosis
Hypothenar muscles

Fig. 8.43 Anterior view of forearm and hand with skin reflected, demonstrating superficial structures.

DISSECTION **TIP**

The palmaris longus muscle is absent in roughly 10% of the population.

- Dissect out the deep fascia and the connective tissue over the tendons and the muscles of the flexor compartment (Figs. 8.46 and 8.47).
- Expose the tendon insertions of the flexor carpi ulnaris and flexor carpi radialis muscles (Fig. 8.48).
- Deep to the palmaris longus muscle, note the **flexor digitorum superficialis muscle.**

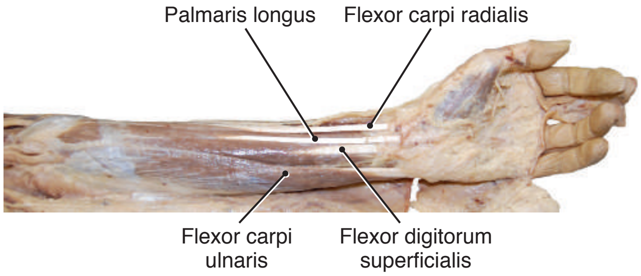

Palmaris longus
Flexor carpi radialis
Flexor carpi ulnaris
Flexor digitorum superficialis

Fig. 8.45 Anterior view of forearm and hand showing muscle-tendon units.

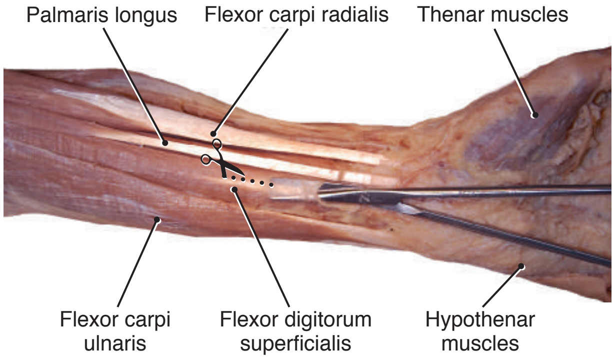
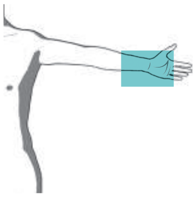

Palmaris longus
Flexor carpi radialis
Thenar muscles
Flexor carpi ulnaris
Flexor digitorum superficialis
Hypothenar muscles

Fig. 8.46 Anterior forearm and hand demonstrating muscle-tendon units.



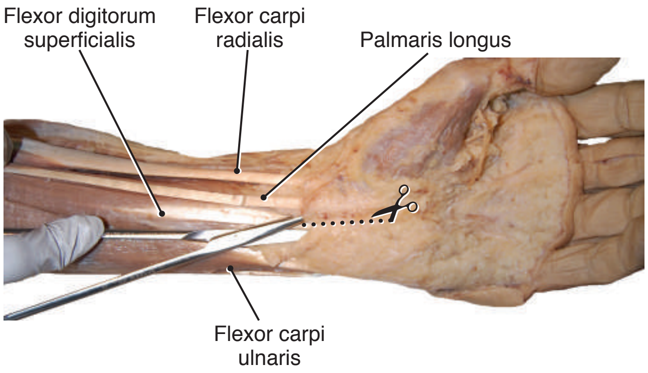

Flexor digitorum superficialis
Flexor carpi radialis
Palmaris longus
Flexor carpi ulnaris

Fig. 8.47 Anterior forearm and hand, highlighting muscle-tendon units.

- Retract the flexor carpi ulnaris, and in the space between it and the **flexor digitorum superficialis,** identify a thick bundle of connective tissue encircling the **ulnar artery and nerve** (Fig. 8.49).
- With the aid of scissors, separate the connective tissue over the ulnar artery and nerve (Fig. 8.50).
- Further retract the flexor digitorum superficialis muscle, and clean and expose the ulnar artery and nerve along the entire length of the forearm (Figs. 8.51 and 8.52).
- Underneath the flexor digitorum superficialis, identify the **flexor digitorum profundus** muscle.
- Clean the loose connective tissue over the flexor digitorum profundus (Fig. 8.53).
- Identify the **radial artery** between the brachioradialis and flexor carpi radialis muscles (Fig. 8.54).
- Further retract the brachioradialis muscle, and expose the radial artery in the forearm (Figs. 8.55 and 8.56).
- Parallel to the radial artery, identify and expose the **superficial branch of the radial nerve** (Fig. 8.57).

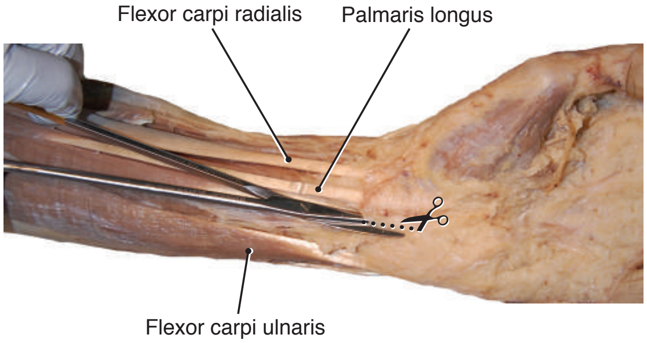
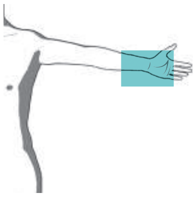

Flexor carpi radialis
Palmaris longus
Flexor carpi ulnaris

Fig. 8.48 Anterior view of forearm and hand showing muscle-tendon units.



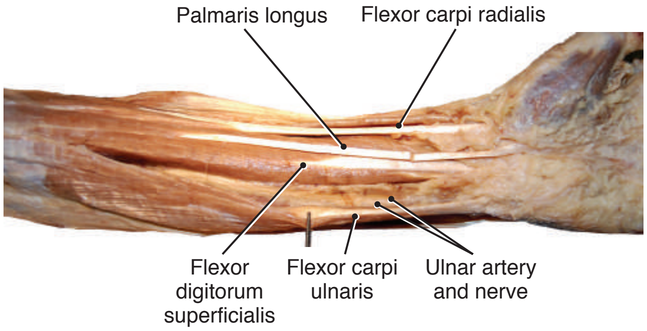
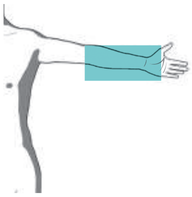

Palmaris longus
Flexor carpi radialis
Flexor digitorum superficialis
Flexor carpi ulnaris
Ulnar artery and nerve

Fig. 8.49 Anterior forearm and hand view, demonstrating muscle-tendon units, with traction of flexor carpi ulnaris.



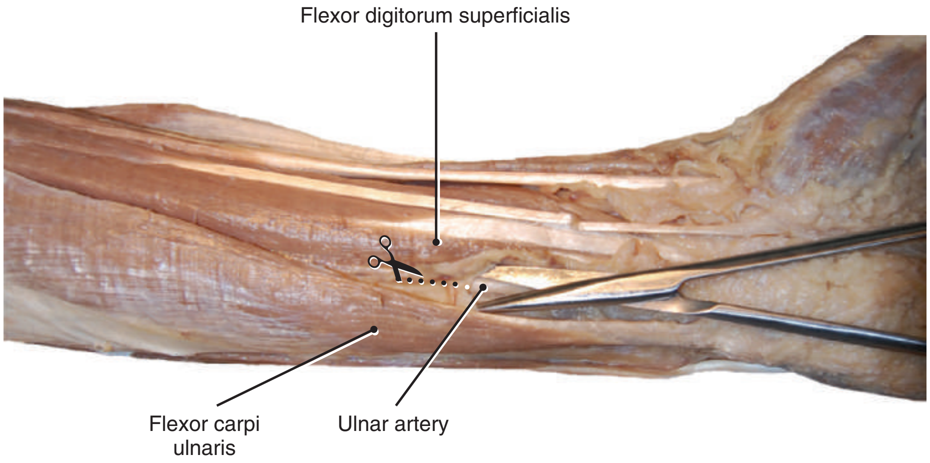
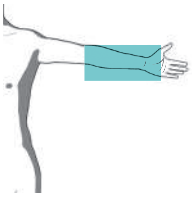

Flexor digitorum superficialis
Flexor carpi ulnaris
Ulnar artery

Fig. 8.50 Anterior view of forearm and wrist demonstrating muscle-tendon units.



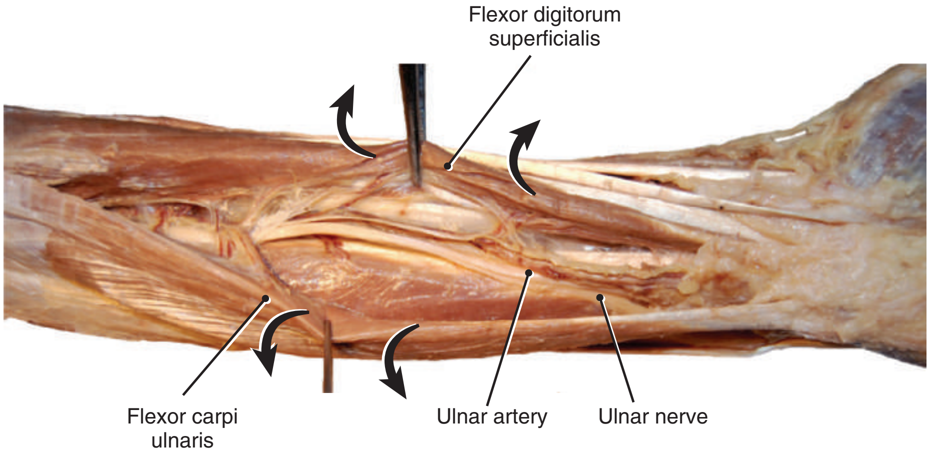
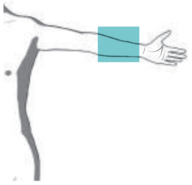

Flexor digitorum superficialis
Flexor carpi ulnaris
Ulnar artery
Ulnar nerve

Fig. 8.51 Anterior forearm with traction to flexor digitorum superficialis muscle, showing intermediate layer.



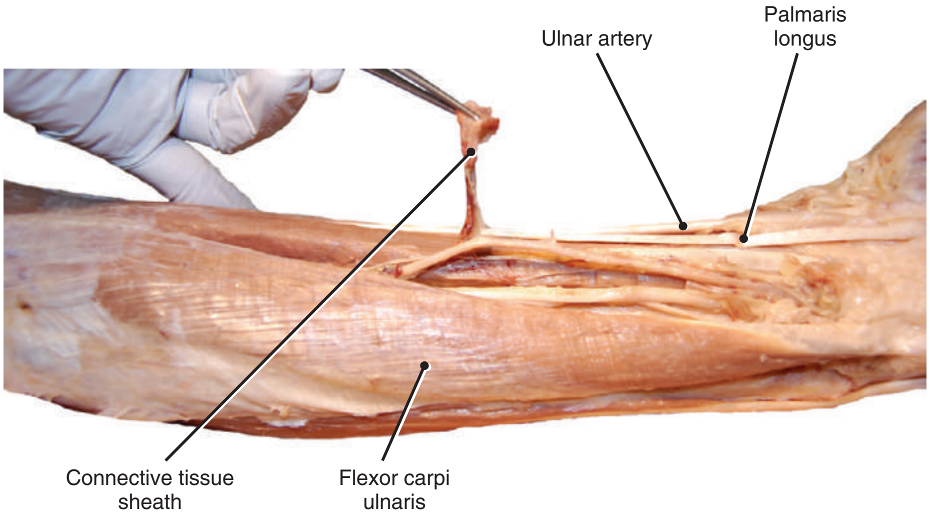
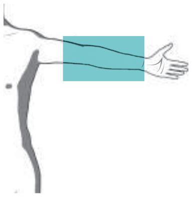

Ulnar artery
Palmaris longus
Connective tissue sheath
Flexor carpi ulnaris

Fig. 8.52 Anterior forearm noting the flexor carpi ulnaris and palmaris longus muscles.



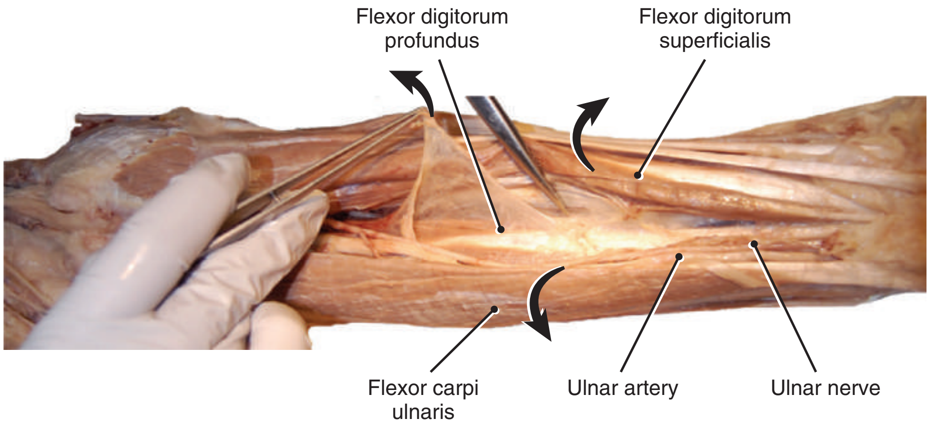
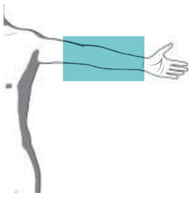

Flexor digitorum profundus
Flexor digitorum superficialis
Flexor carpi ulnaris
Ulnar artery
Ulnar nerve

Fig. 8.53 Anterior forearm view with traction to flexor digitorum superficialis muscle, exposing the flexor digitorum profundus.



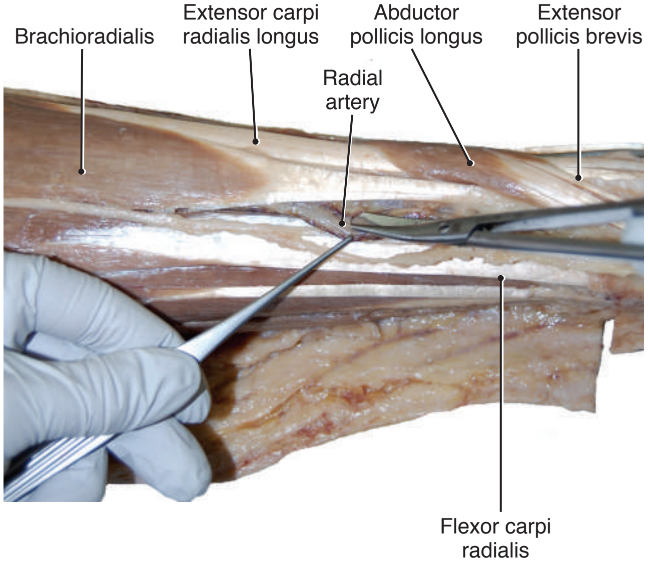
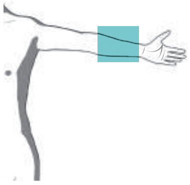

Brachioradialis
Extensor carpi radialis longus
Abductor pollicis longus
Extensor pollicis brevis
Radial artery
Flexor carpi radialis

Fig. 8.54 Anterolateral view of distal forearm, demonstrating radial neurovascular bundle.



DISSECTION **TIP**

Note the following landmarks in the course of the radial artery:

- Passes superficial to the pronator teres muscle.
- Travels deep to the brachioradialis muscle.

At the wrist, the radial artery is found between the tendons of the flexor carpi radialis and the brachioradialis muscles. This point is used to feel the radial pulse or to perform arterial catheterization.

- The flexor digitorum profundus muscle inserts onto the bases of the distal phalanx of each of the medial four digits.

DISSECTION **TIP**

A common variation of the flexor digitorum profundus is that its tendon to the 2nd digit may form an independent muscle. The flexor pollicis longus muscle inserts onto the distal phalanx of the 1st digit.

- The flexor digitorum superficialis muscle inserts onto the base of the middle phalanx of digits 2 to 5. However, the tendon to the 5th digit may be absent.
- Expose the radial artery (Fig. 8.58).

CUBITAL FOSSA AND FLEXOR COMPARTMENT

- Cut the bicipital aponeurosis (Fig. 8.59) to trace the radial artery to its branch point from the brachial artery.
- Coursing with the ulnar artery, identify the median nerve, and the vena comitans (Fig. 8.60).
- Lift the brachial and radial arteries, and expose the ulnar artery with its branches (Fig. 8.61).
- At this point, use a retractor between the brachioradialis and the flexor digitorum superficialis muscles to expose deeper structures (Fig. 8.62).
- Follow the course of the ulnar and radial arteries, and identify the recurrent ulnar and recurrent radial arteries.
- Identify the **pronator teres** and its two heads; the humeral (superficial) head is attached to the medial epicondyle and the ulnar (deep) head to the coronoid process of the ulna.
- Trace the course of the medial nerve as it travels from the cubital fossa and then enters the forearm between the two heads of the pronator teres (see Fig. 8.62).
- Note the ulnar artery entering the forearm deep to the ulnar (deep) head of the pronator teres muscle (see Fig. 8.62).

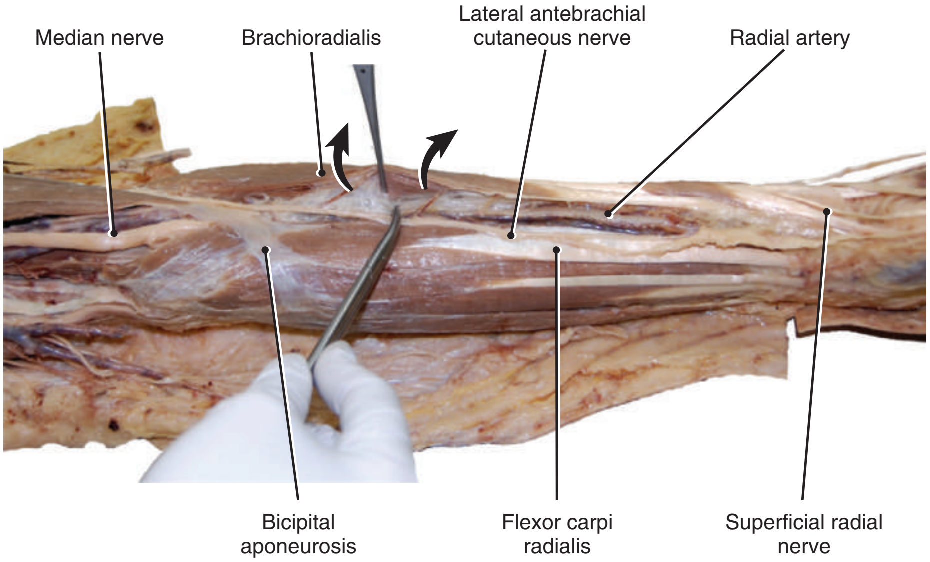
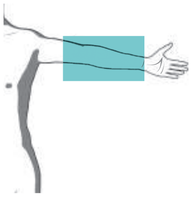

Median nerve
Brachioradialis
Lateral antebrachial cutaneous nerve
Radial artery
Bicipital aponeurosis
Flexor carpi radialis
Superficial radial nerve

Fig. 8.55 Anteromedial view of forearm with skin reflected, demonstrating radial artery and vein.



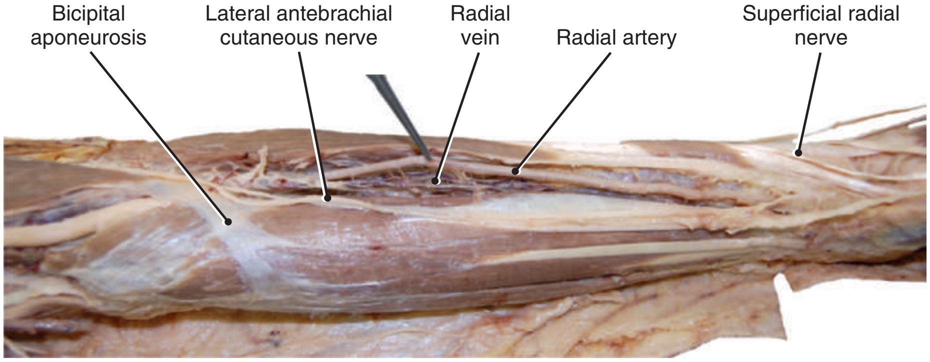
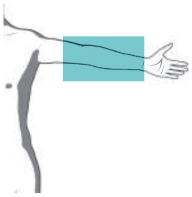

Bicipital aponeurosis
Lateral antebrachial cutaneous nerve
Radial vein
Radial artery
Superficial radial nerve

Fig. 8.56 Anterior forearm view with skin reflected, demonstrating radial artery and vein.



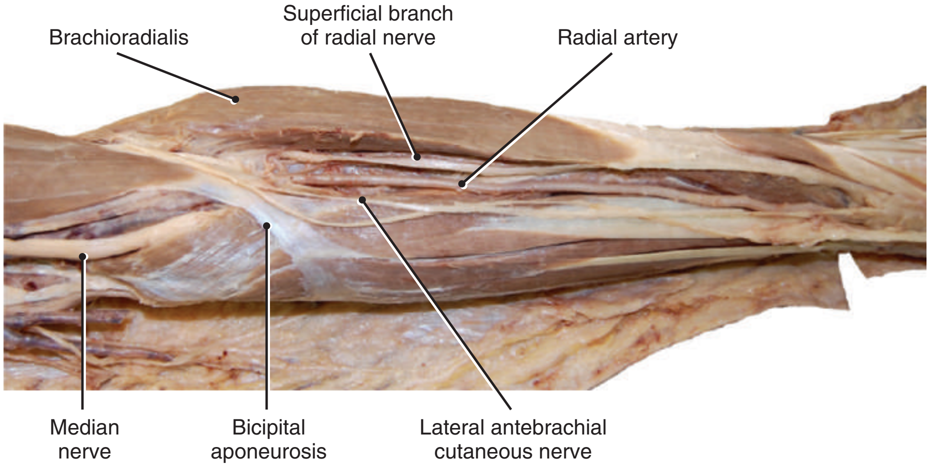
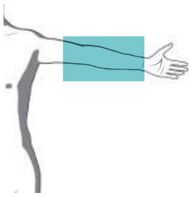

Brachioradialis
Superficial branch of radial nerve
Radial artery
Median nerve
Bicipital aponeurosis
Lateral antebrachial cutaneous nerve

Fig. 8.57 Anterior forearm view, showing radial artery, vein, and nerve.



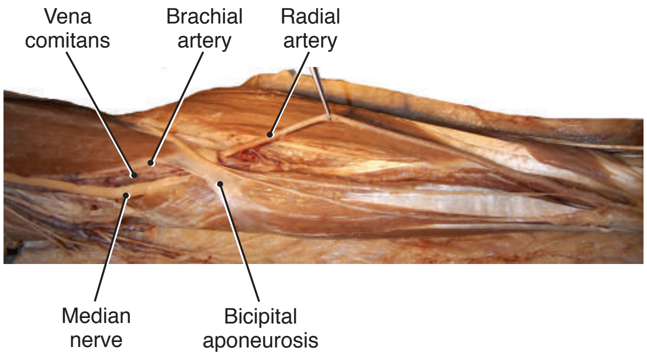
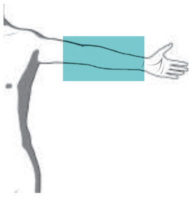

Vena comitans
Brachial artery
Radial artery
Median nerve
Bicipital aponeurosis

Fig. 8.58 Anterior forearm view with radial artery and traction, demonstrating musculature.



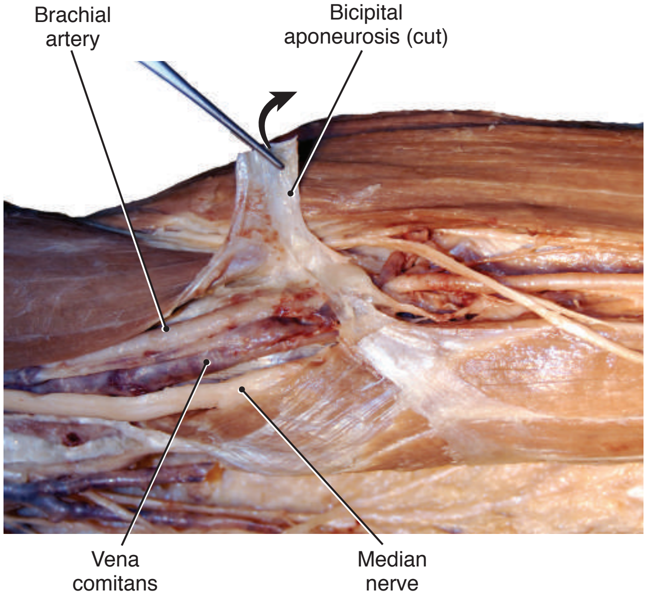
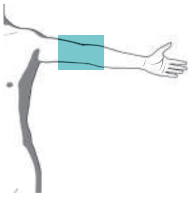

Brachial artery
Bicipital aponeurosis (cut)
Vena comitans
Median nerve

Fig. 8.59 Anterior view of cubital fossa with bicipital aponeurosis reflected, demonstrating brachial artery and median nerve.



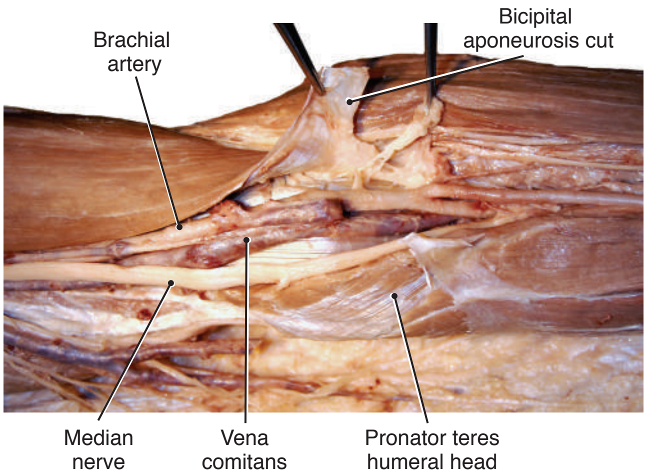
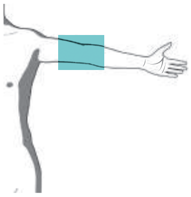

Brachial artery
Bicipital aponeurosis cut
Median nerve
Vena comitans
Pronator teres humeral head

Fig. 8.60 Anterior cubital fossa view with bicipital aponeurosis reflected, highlighting brachial artery and median nerve.



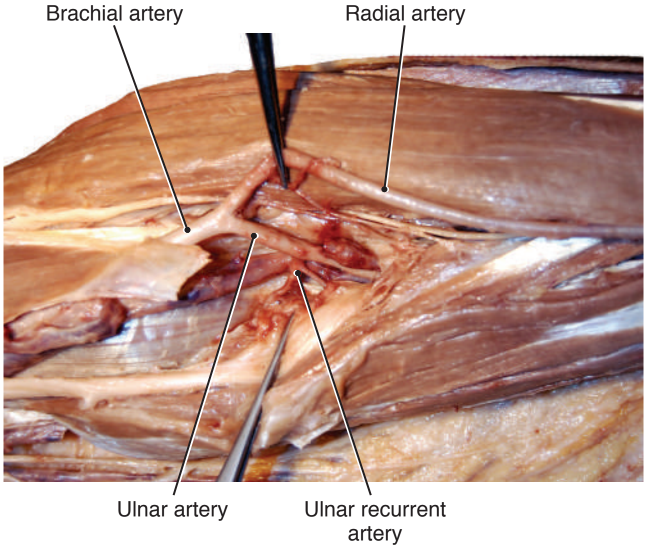
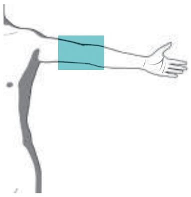

Brachial artery
Radial artery
Ulnar artery
Ulnar recurrent artery

Fig. 8.61 Anterior view of cubital fossa with bicipital aponeurosis cut, demonstrating the bifurcation of the brachial artery.



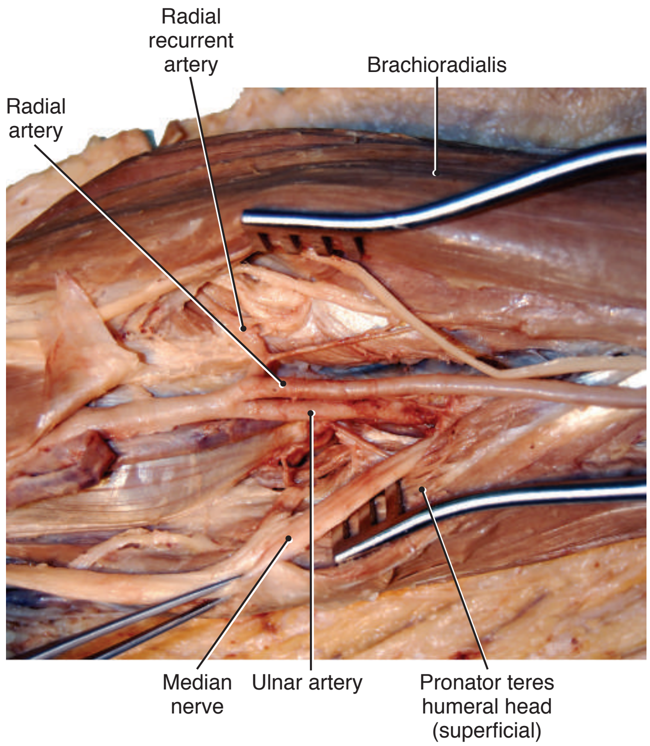
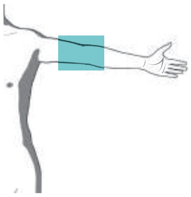

Radial recurrent artery
Brachioradialis
Radial artery
Median nerve
Ulnar artery
Pronator teres humeral head (superficial)

Fig. 8.62 Anterior cubital fossa view with bicipital aponeurosis reflected, exposing neurovascular structures.



- Lift up the median nerve, and identify its muscular branches (Fig. 8.63).

DISSECTION TIP

To continue the dissection, the vena comitans must be removed (Fig. 8.64). Cut the veins in the cubital fossa and as distal as possible in the forearm. Use paper towels to absorb any fluid that issues from the cut veins.

- Expose the borders of the pronator teres, and retract the radial artery (Fig. 8.65).
- Carefully **split the humeral head of the pronator teres** (Fig. 8.66) from the underlying ulnar (deep) head and flexor digitorum superficialis muscle (Figs. 8.67 and 8.68).
- Lift the median nerve and expose its course in the deep flexor compartment of the forearm (Fig. 8.69).
- Dissect distally the **ulnar artery** and identify the common interosseous artery (Fig. 8.70).
- The common interosseous artery arises from the ulnar artery and then divides into the anterior and posterior interosseous branches (Fig. 8.71).

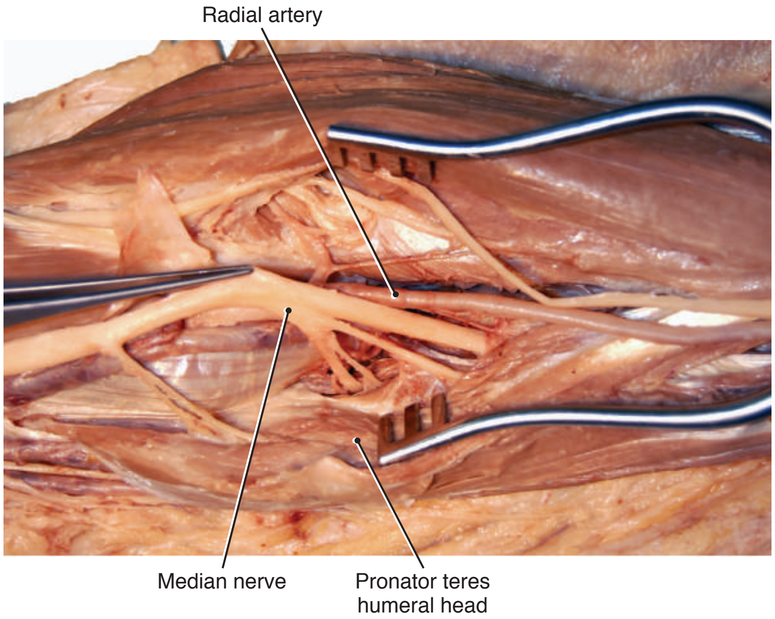
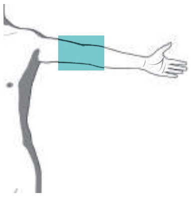

Radial artery
Median nerve
Pronator teres humeral head

Fig. 8.63 Cubital fossa view with bicipital aponeurosis reflected, demonstrating neurovascular structures.



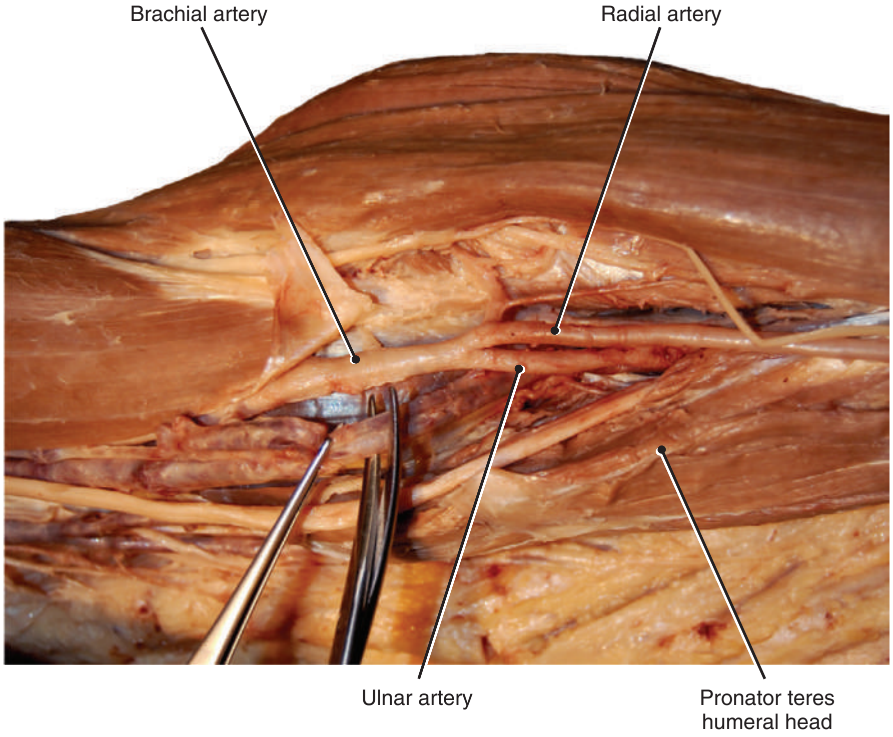
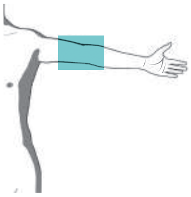

Brachial artery
Radial artery
Ulnar artery
Pronator teres humeral head

Fig. 8.64 Anterior view of cubital fossa with bicipital aponeurosis reflected, highlighting neurovascular structures.



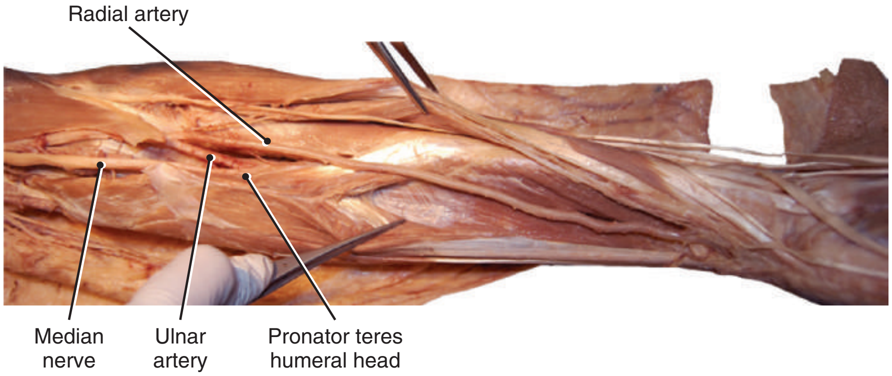
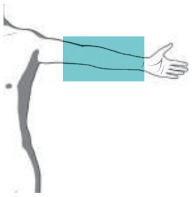

Radial artery
Median nerve
Ulnar artery
Pronator teres humeral head

Fig. 8.65 Anterolateral forearm view with skin reflected, demonstrating radial artery and musculature.



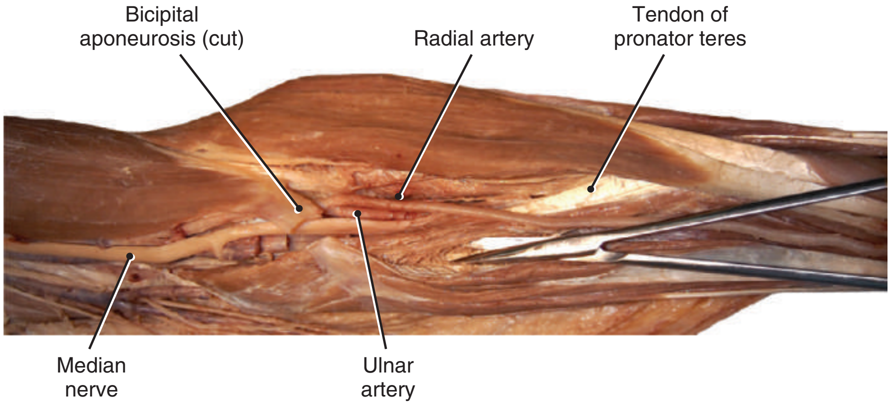
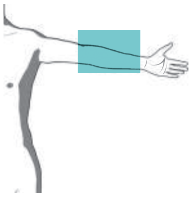

Bicipital aponeurosis (cut)
Radial artery
Tendon of pronator teres
Median nerve
Ulnar artery

Fig. 8.66 Anterior cubital fossa with bicipital aponeurosis cut, exposing median nerve, radial artery, and pronator teres muscle.



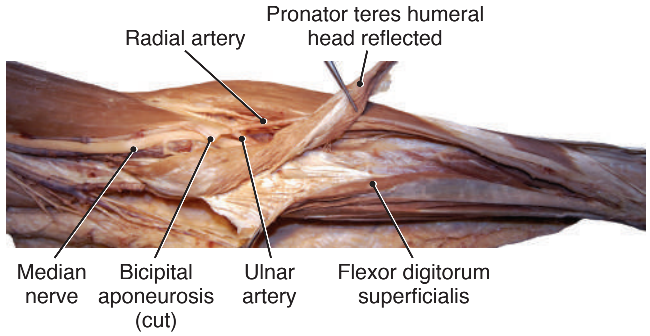
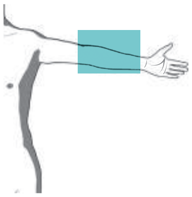

Pronator teres humeral head reflected
Radial artery
Median nerve
Bicipital aponeurosis (cut)
Ulnar artery
Flexor digitorum superficialis

Fig. 8.67 Anterior view of lateral cubital fossa and forearm with reflected pronator teres, demonstrating musculature.



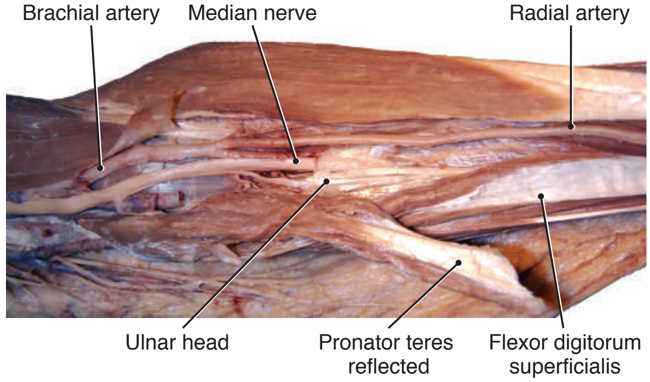
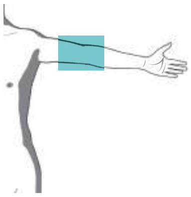

Brachial artery
Median nerve
Radial artery
Ulnar head
Pronator teres reflected
Flexor digitorum superficialis

Fig. 8.68 Anterior cubital fossa view with pronator teres muscle reflected, demonstrating deeper structures.



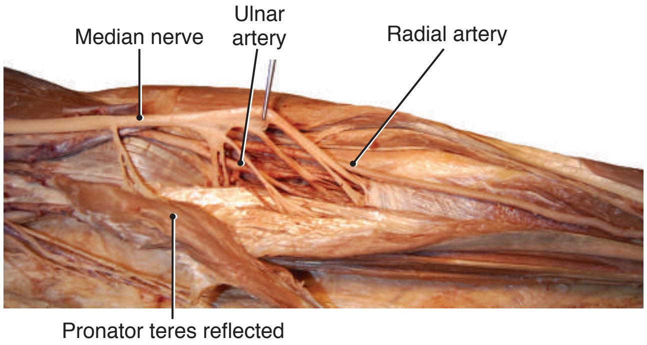
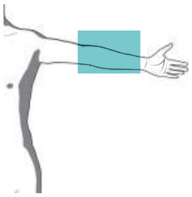

Median nerve
Ulnar artery
Radial artery
Pronator teres reflected

Fig. 8.69 Anterior cubital fossa view with superficial (humeral) head of pronator teres muscle reflected, and median nerve traction demonstrating deep (ulnar) head of pronator teres.



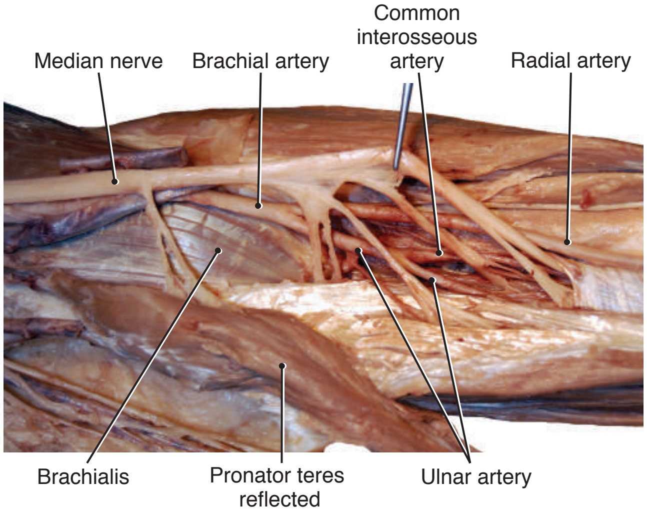
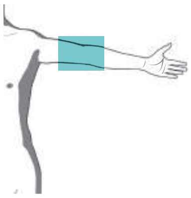
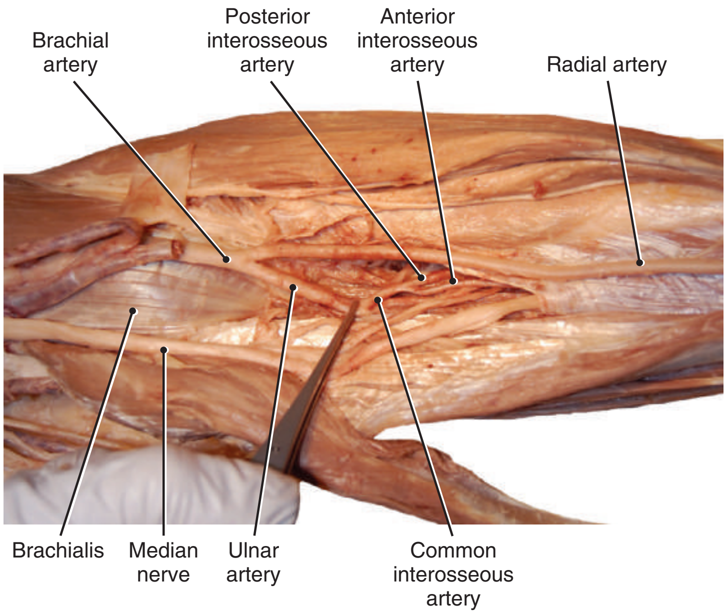

Median nerve
Brachial artery
Common interosseous artery
Radial artery
Brachialis
Pronator teres reflected
Ulnar artery

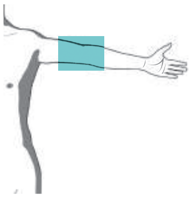
Fig. 8.70 Anterior cubital fossa view with superficial pronator teres head reflected, and median nerve traction demonstrating deep pronator teres head, and radial and ulnar arteries.

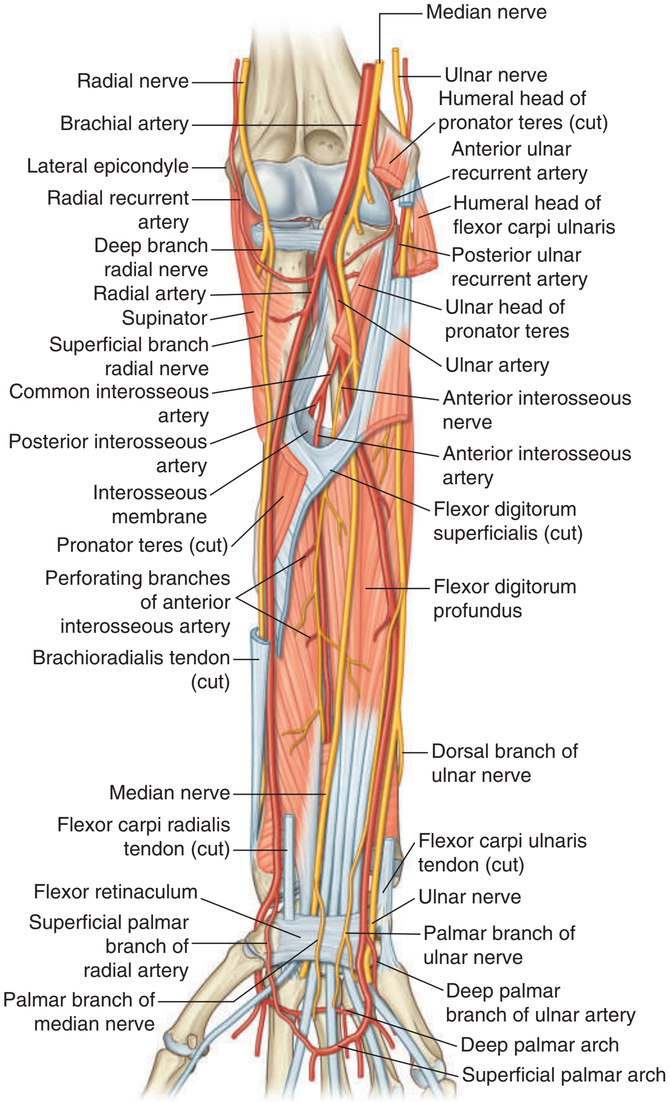




Brachial artery
Posterior interosseous artery
Anterior interosseous artery
Radial artery
Brachialis
Median nerve
Ulnar artery
Common interosseous artery

Fig. 8.71 Anterior cubital fossa view with superficial head of pronator teres reflected, and median nerve traction demonstrating deep head of pronator teres and radial and ulnar arteries.





Median nerve
Radial nerve
Ulnar nerve
Humeral head of pronator teres (cut)
Brachial artery
Anterior ulnar recurrent artery
Lateral epicondyle
Radial recurrent artery
Humeral head of flexor carpi ulnaris
Deep branch radial nerve
Posterior ulnar recurrent artery
Radial artery
Ulnar head of pronator teres
Supinator
Superficial branch radial nerve
Ulnar artery
Common interosseous artery
Anterior interosseous nerve
Posterior interosseous artery
Anterior interosseous artery
Interosseous membrane
Flexor digitorum superficialis (cut)
Pronator teres (cut)
Perforating branches of anterior interosseous artery
Flexor digitorum profundus
Brachioradialis tendon (cut)
Dorsal branch of ulnar nerve
Median nerve
Flexor carpi radialis tendon (cut)
Flexor carpi ulnaris tendon (cut)
Flexor retinaculum
Ulnar nerve
Superficial palmar branch of radial artery
Palmar branch of ulnar nerve
Palmar branch of median nerve
Deep palmar branch of ulnar artery
Deep palmar arch
Superficial palmar arch

Plate 8.3 Arteries and nerve of the flexor compartment of the forearm.

- **The posterior interosseous artery passes through the interosseous membrane to reach the extensor compartment of the forearm.**
- **As the median nerve is lifted, identify the anterior interosseous nerve, which arises from the median nerve just proximal to the pronator teres muscle (see Figs. 8.70 and 8.71, Plate 8.3).**

DEEP FLEXOR COMPARTMENT

- **Cut the tendons of the flexor digitorum superficialis, or widely retract them, and identify the flexor digitorum profundus and flexor pollicis longus muscles (Fig. 8.72).**
- **Finally, identify the pronator quadratus, which connects the distal portions of the ulna and radius (Fig. 8.73).**
- **In the space between the flexor pollicis longus and flexor digitorum profundus muscles, trace the course of the anterior interosseous artery and anterior interosseous nerve, a branch of the median nerve (see Figs. 8.72 and 8.73).**

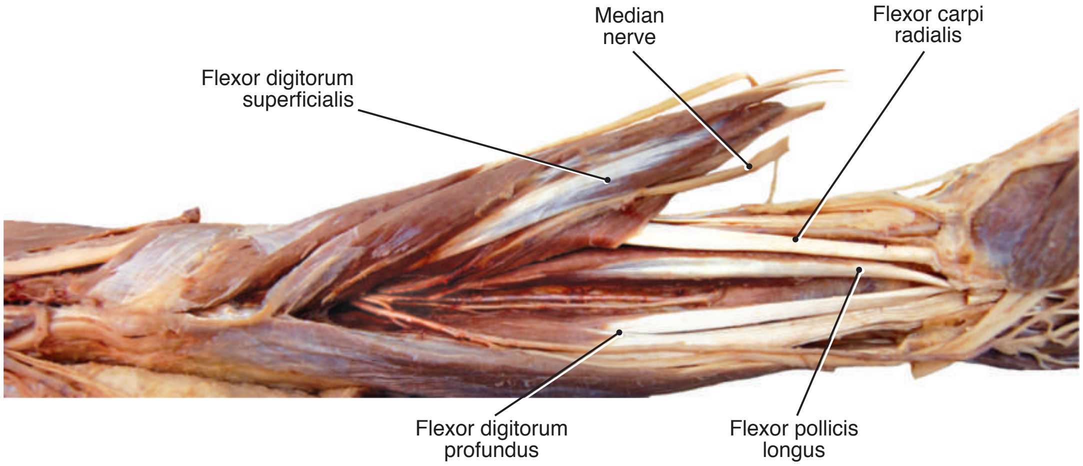
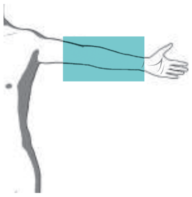

Median nerve
Flexor carpi radialis
Flexor digitorum superficialis
Flexor digitorum profundus
Flexor pollicis longus

Fig. 8.72 Anterior forearm view with superficial and intermediate muscle layers cut and reflected, exposing deeper structures.



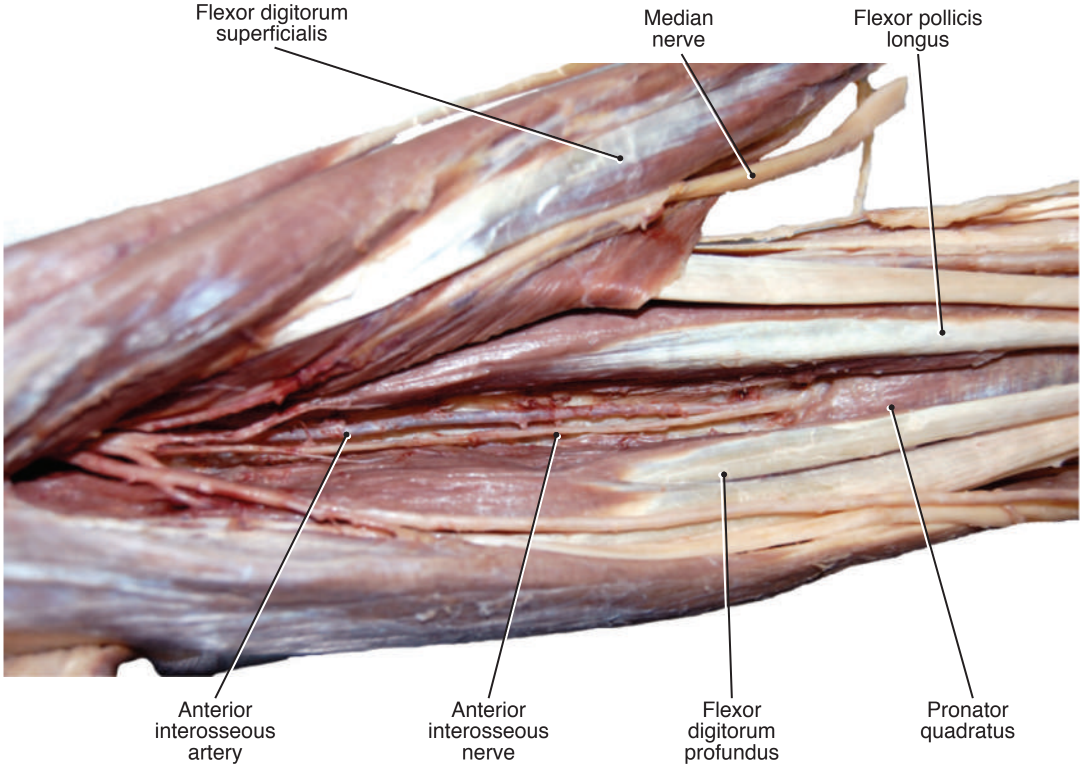
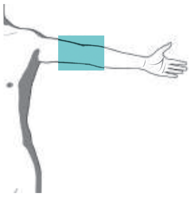

Flexor digitorum superficialis
Median nerve
Flexor pollicis longus
Anterior interosseous artery
Anterior interosseous nerve
Flexor digitorum profundus
Pronator quadratus

Fig. 8.73 Anterior view of forearm with superficial and intermediate muscle layers cut and reflected, demonstrating deeper structures.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Musculocutaneous
- ☐ Lateral antebrachial cutaneous
- ☐ Median
- ☐ Anterior interosseous
- ☐ Medial brachial cutaneous
- ☐ Medial antebrachial cutaneous
- ☐ Ulnar
- ☐ Radial
- ☐ Posterior interosseous

ARTERIES

- ☐ Brachial
- ☐ Radial
- ☐ Radial recurrent
- ☐ Interosseous recurrent
- ☐ Ulnar
- ☐ Common interosseous
- ☐ Anterior interosseous
- ☐ Posterior interosseous
- ☐ Ulnar anterior recurrent
- ☐ Ulnar posterior recurrent

VEINS

Superficial

- ☐ Cephalic
- ☐ Basilic
- ☐ Cubital

Deep

- ☐ Brachial
- ☐ Radial
- ☐ Ulnar

MUSCLES

Anterior Compartment of Arm

- ☐ Coracobrachialis
- ☐ Biceps brachii
  - ☐ Long head
  - ☐ Short head
- ☐ Brachialis

Posterior Compartment of Arm

- ☐ Triceps brachii
  - ☐ Long head
  - ☐ Lateral head
  - ☐ Medial head
- ☐ Anconeus

Anterior Compartment of Forearm

Superficial Layer

- ☐ Pronator teres
  - ☐ Humeral (superficial) head
  - ☐ Ulnar (deep) head
- ☐ Flexor carpi radialis
- ☐ Palmaris longus
- ☐ Flexor carpi ulnaris

Intermediate Layer

- ☐ Flexor digitorum superficialis

Deep Layer

- ☐ Flexor digitorum profundus
- ☐ Flexor pollicis longus
- ☐ Pronator quadratus

Posterior Compartment of Forearm

Superficial Layer

- ☐ Brachioradialis
- ☐ Extensor carpi radialis longus
- ☐ Extensor carpi radialis brevis
- ☐ Extensor digitorum
- ☐ Extensor digiti minimi
- ☐ Extensor carpi ulnaris

Deep Layer

- ☐ Supinator
- ☐ Abductor pollicis longus
- ☐ Extensor pollicis longus
- ☐ Extensor pollicis brevis
- ☐ Extensor indicis

LIGAMENTS

- ☐ Ulnar collateral
- ☐ Radial collateral
- ☐ Anular

CONNECTIVE TISSUE

- ☐ Bicipital aponeurosis
- ☐ Antebrachial fascia
- ☐ Flexor retinaculum
- ☐ Extensor retinaculum

BONES

- ☐ Scapula
- ☐ Humerus
- ☐ Radius
- ☐ Ulna
- ☐ Carpals
- ☐ Metacarpals
- ☐ Phalanges

ATLAS REFERENCES

Netter: 442–469
McMinn: 154–169
Gray's Atlas: 426–429, 440–456

BEFORE YOU BEGIN

Palpation

Flex and extend your digits, noting the movements of the tendons beneath the skin. On the dorsal side of your hand, identify the tendons of the extensor digitorum muscle. At the flexor aspect of the palm, note the distal skin crease (crease between wrist and forearm), marking the proximal edge of the flexor retinaculum (Fig. 9.1).

- At the ulnar side of the distal skin crease, palpate the pisiform bone. At the radial side of the distal skin crease, palpate the scaphoid bone. Immediately beneath the radial and ulnar sides of the distal skin crease, palpate the **radial** and **ulnar styloid processes**, respectively.
- By flexing the closed fist against resistance, you should be able to identify several tendons at the anterior wrist, from medial to lateral: the flexor carpi ulnaris, flexor digitorum superficialis, palmaris longus, and flexor carpi radialis. However, the most prominent tendons are those of the palmaris longus, lying at the midline, and the flexor carpi radialis, lying in the radial side. Lateral to the tendon of the flexor carpi radialis, you can palpate the radial artery. The pulsations of the ulnar artery are more difficult to detect but usually are felt about 3 cm proximal to the pisiform bone, lateral to the flexor carpi ulnaris muscle. Note the thenar and hypothenar eminences, which contain muscles of the 1st digit and the 5th digit, respectively.

On the dorsum surface of the hand, extend the 1st digit, noting the tendons of the abductor pollicis longus (to base of 1st metacarpal bone), the extensor pollicis brevis (to base of 1st phalanx), and the extensor pollicis longus muscles (to base of distal phalanx of 1st digit) forming the "anatomic snuffbox" (Fig. 9.2). This anatomic area is important because the radial artery lies on the scaphoid bone and passes to reach the dorsum of the 1st digit.

If the dorsum of the hand has not been dissected already on your cadaver as it was in Chapter 8, then refer to Chapter 8, Figs. 8.12 to 8.16 before proceeding to the palmar dissection (Fig. 9.3).

PALMAR HAND

○ **Make a similar midline incision on the palmar surface, starting from the distal palmar crease to the base of**

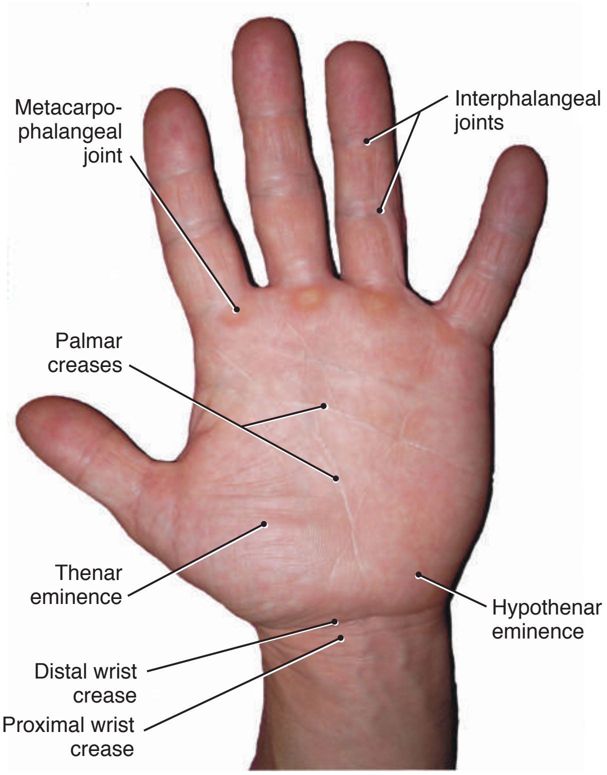


Fig. 9.1 Anterior view of palmar surface of hand. Note positioning of interphalangeal and metacarpal phalangeal joints, palmar and wrist creases, and thenar and hypothenar eminences.

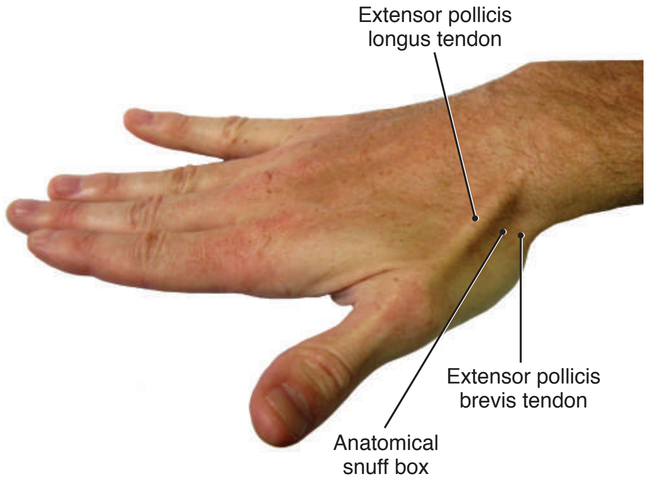

Extensor pollicis longus tendon
Extensor pollicis brevis tendon
Anatomical snuff box

Fig. 9.2 Dorsolateral view of wrist, noting "anatomic snuffbox," which is bordered by the underlying extensor pollicis longus and brevis tendons.

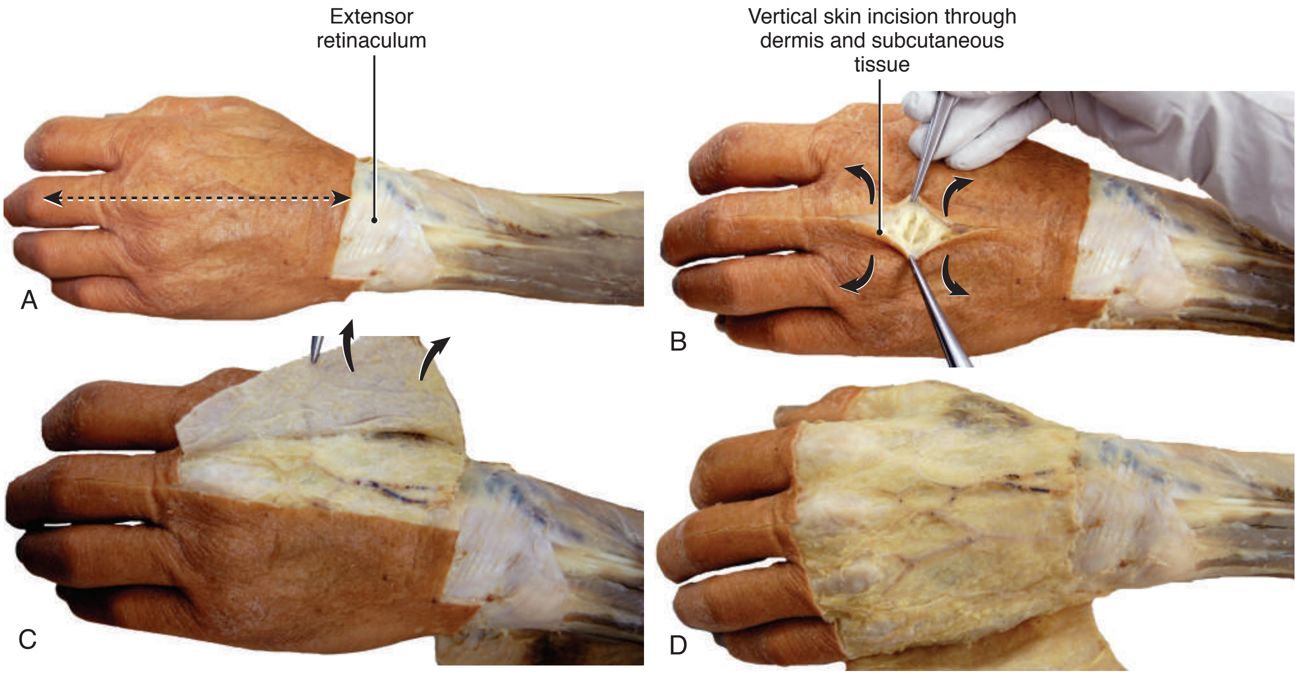

Extensor retinaculum
Vertical skin incision through dermis and subcutaneous tissue
A
B
C
D

Fig. 9.3 Make a midline incision on the dorsal surface of the hand as indicated in Chapter 8 (Figs. 8.12 to 8.16).

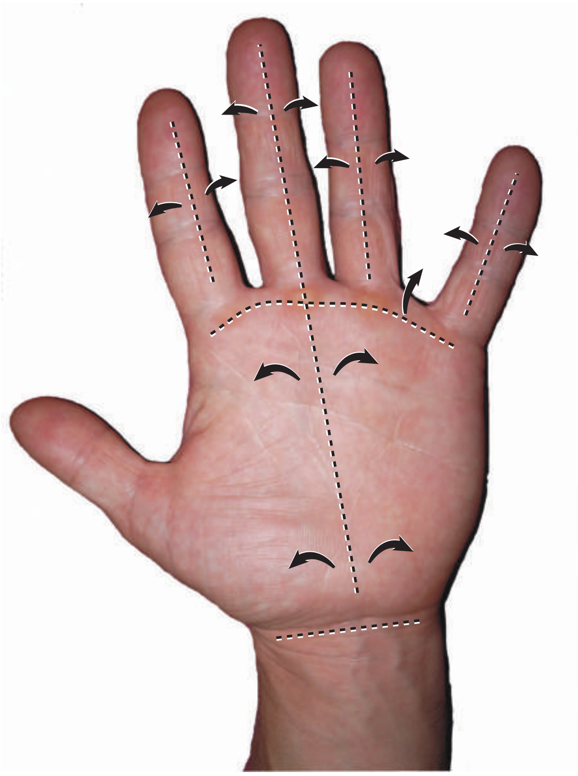


Fig. 9.4 Anterior view of palmar hand, with dashed lines showing skin incision sites.

the 3rd digit (Fig. 9.4). Make a second midline incision on the palmar surface of each digit. Join these with transverse incisions at the bases of the digits.

- With additional incisions as necessary, reflect and remove the skin from the hand (Fig. 9.5).

DISSECTION **TIP**

The skin on the dorsum of the hand is very thin, whereas the skin on the palmar surface is thick and tightly bound to the underlying palmar aponeurosis. Make a shallow incision on the dorsum of the hand, and with the aid of dissecting scissors, separate the skin from the underlying tissues. Make a deeper incision on the palmar surface of the hand, using the palmaris longus muscle as a guide to remove the skin with sharp dissection.

- After removal of the skin on the palmar surface of the hand, trace the continuation of the palmaris longus muscle to the palmar aponeurosis (see Fig. 9.5).
- Note the **thenar eminence** with the **flexor pollicis brevis** and **abductor pollicis muscles** (Fig. 9.6).
- Lift the palmar aponeurosis (Fig. 9.7) and with the aid of dissecting scissors separate it from the underlying structures (Fig. 9.8).

ANATOMY **NOTE**

The *palmar aponeurosis* is composed of longitudinal and transversely oriented fibers of dense connective tissue. The longitudinal fibers form digital bands that attach to the bases of the proximal phalanges and become continuous with the fibrous digital sheaths (ligamentous tubes enclosing synovial sheaths).

- With scissors, cut the attachments of the longitudinal bands from the bases of the proximal phalanges. Reflect the palmaris longus muscle and the palmar aponeurosis toward the forearm (Fig. 9.9).

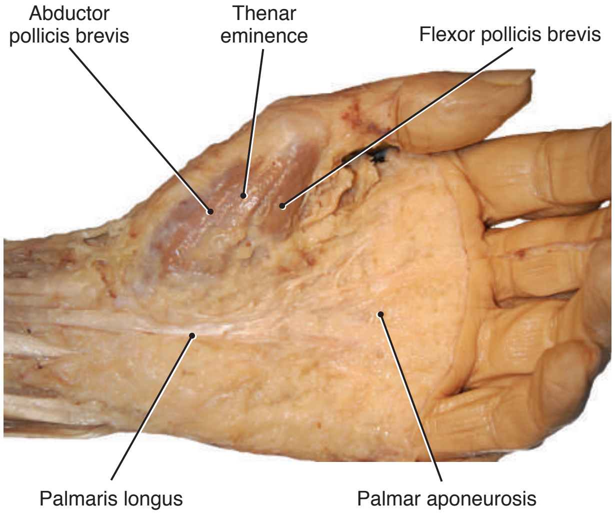

Abductor pollicis brevis
Thenar eminence
Flexor pollicis brevis
Palmaris longus
Palmar aponeurosis

Fig. 9.5 Anterior view of hand with skin reflected, noting superficial structures, including muscles of thenar eminence and the palmar aponeurosis. Note palmaris longus muscle inserting into palmar aponeurosis.

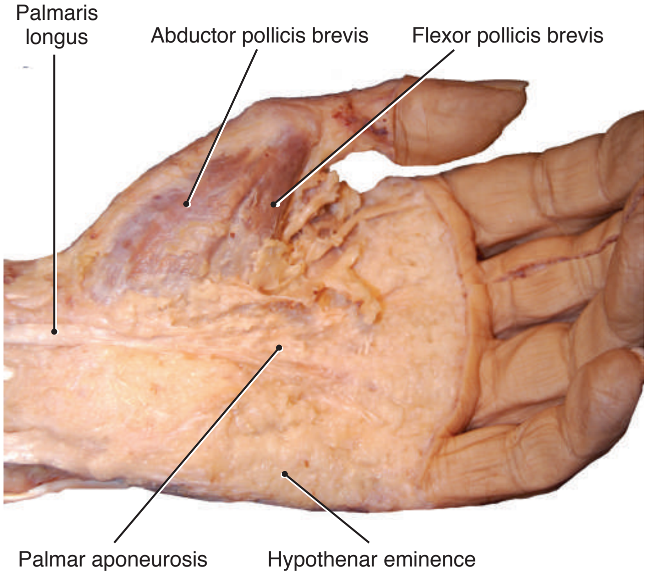

Palmaris longus
Abductor pollicis brevis
Flexor pollicis brevis
Palmar aponeurosis
Hypothenar eminence

Fig. 9.6 Anterior view of hand with skin reflected, illustrating subcutaneous fat covering muscles that make up the hypothenar eminence.

DISSECTION **TIP**

The removal of the palmar aponeurosis takes time. Pay special attention to using the scalpel as little as possible so as not to injure the palmar digital nerves and the superficial palmar arch. These structures travel deep to the palmar aponeurosis.

○ **After removal of the palmar aponeurosis, start exposing the superficial palmar arch (Figs. 9.10 and 9.11, Plate 9.1).**

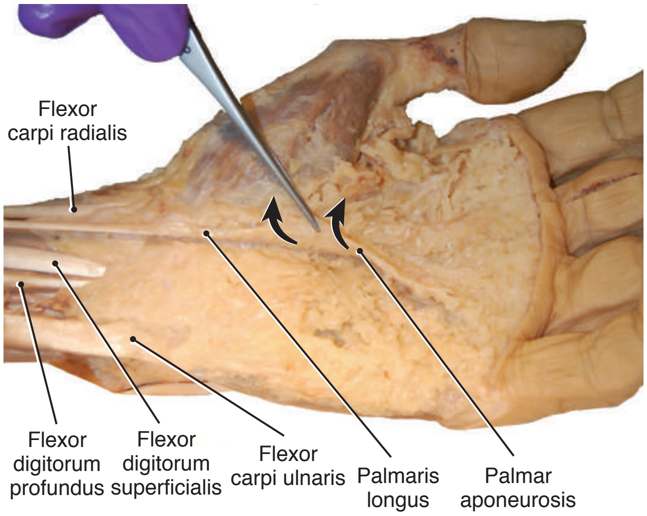

Flexor carpi radialis
Flexor digitorum profundus
Flexor digitorum superficialis
Flexor carpi ulnaris
Palmaris longus
Palmar aponeurosis

Fig. 9.7 Anterior hand with skin reflected and traction on the palmar aponeurosis. The aponeurosis will be reflected to reveal deeper structures.

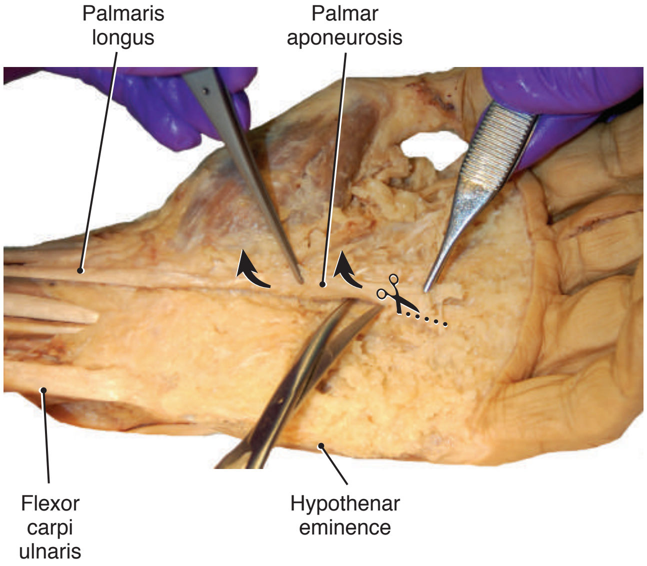

Palmaris longus
Palmar aponeurosis
Flexor carpi ulnaris
Hypothenar eminence

Fig. 9.8 Anterior hand with skin reflected, revealing palmar aponeurosis. Constant tension of the aponeurosis will allow scissors to be inserted deep to it.

ANATOMY **NOTE**

The *superficial palmar arch* is the termination of the superficial branch of the ulnar artery, which gives rise to three common palmar digital arteries. These arteries anastomose with the palmar metacarpal branches from the deep palmar arterial arch. The common palmar digital arteries then divide into a pair of proper digital arteries, supplying the adjacent sides of the 2nd to 4th digits.

DISSECTION **TIP**

The superficial palmar arch is related to the superficial venous arch, as well as with common palmar digital branches of the median nerve. With scissors, separate the nerves from the superficial palmar arch (see Figs. 9.10 to 9.12). Also, remove any venous structures from this area.

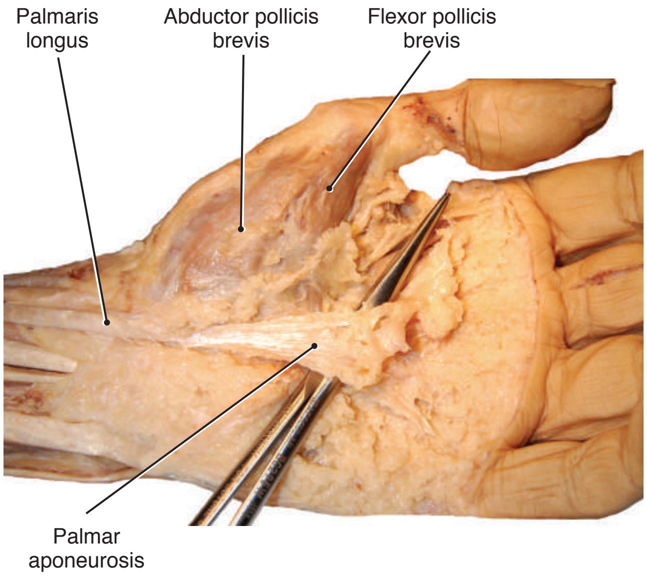

Palmaris longus
Abductor pollicis brevis
Flexor pollicis brevis
Palmar aponeurosis

Fig. 9.9 Anterior hand with skin reflected, revealing palmar aponeurosis. Once the aponeurosis is cut distally, it can be reflected to demonstrate deeper structures.

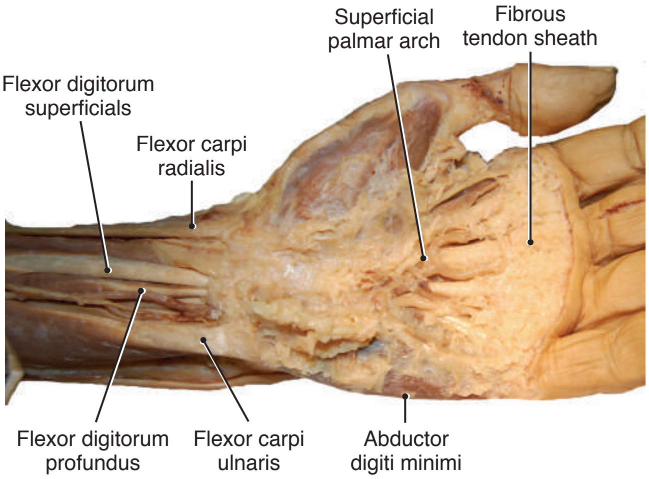

Superficial palmar arch
Fibrous tendon sheath
Flexor digitorum superficials
Flexor carpi radialis
Flexor digitorum profundus
Flexor carpi ulnaris
Abductor digiti minimi

Fig. 9.11 Anterior view of hand with skin and aponeurosis reflected, showing tendon sheaths and neurovascular structures such as superficial palmar arch.

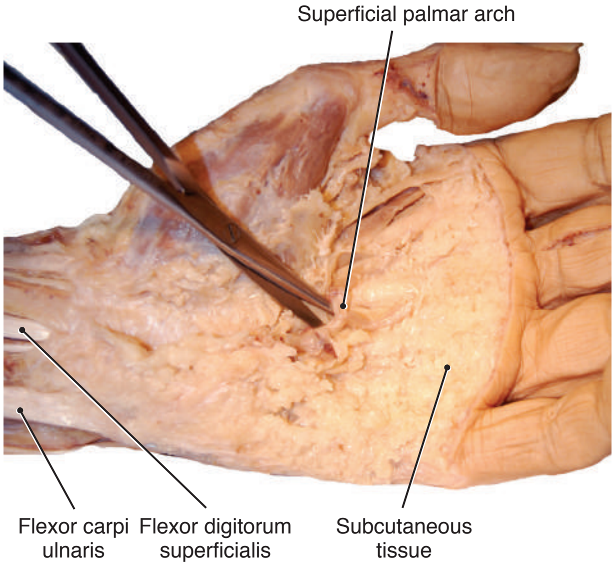

Superficial palmar arch
Flexor carpi ulnaris
Flexor digitorum superficialis
Subcutaneous tissue

Fig. 9.10 Anterior view of hand with skin and aponeurosis reflected, revealing deeper structures such as the superficial palmar arch.

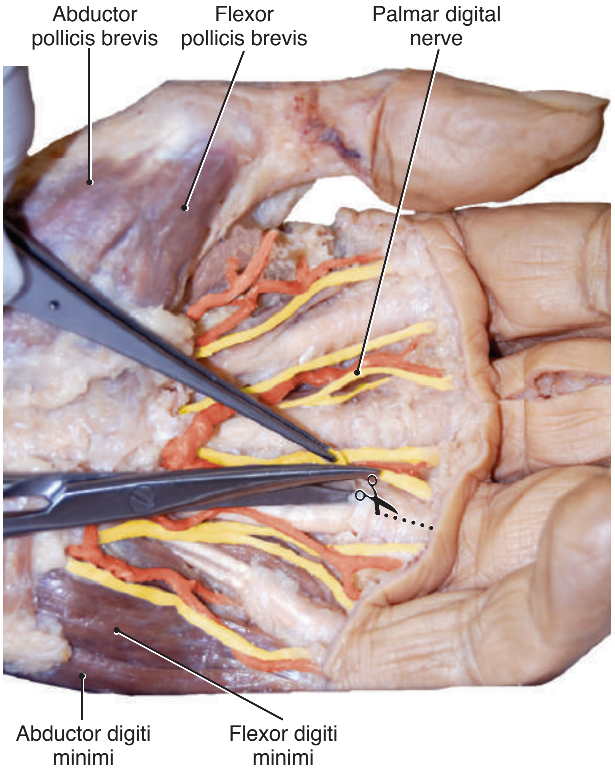

Abductor pollicis brevis
Flexor pollicis brevis
Palmar digital nerve
Abductor digiti minimi
Flexor digiti minimi

Fig. 9.12 Anterior view of hand with skin and aponeurosis reflected, revealing tendon sheaths and adjacent neurovascular structures.

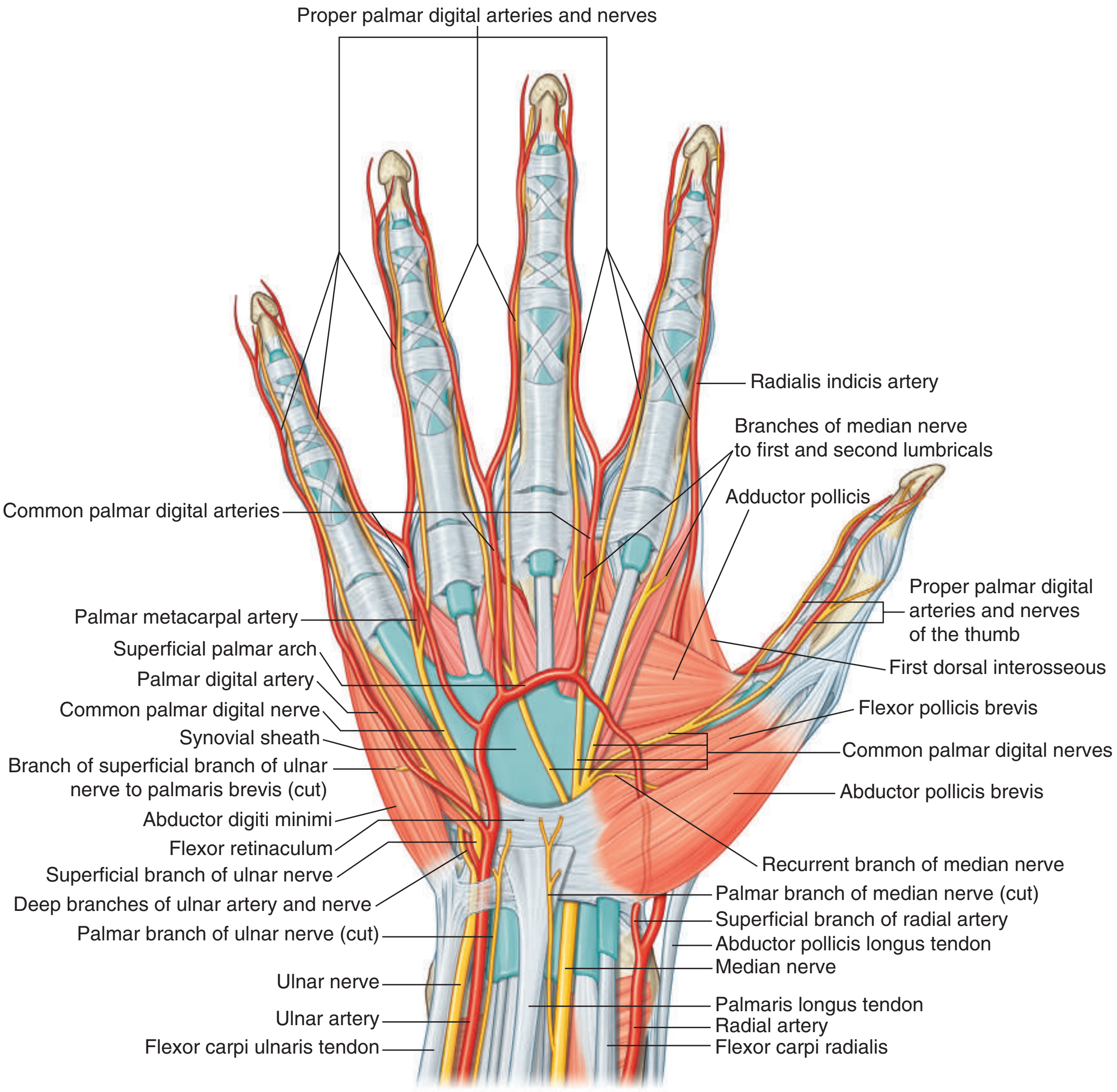

Proper palmar digital arteries and nerves
Radialis indicis artery
Branches of median nerve to first and second lumbricals
Adductor pollicis
Common palmar digital arteries
Proper palmar digital arteries and nerves of the thumb
Palmar metacarpal artery
Superficial palmar arch
First dorsal interosseous
Palmar digital artery
Flexor pollicis brevis
Common palmar digital nerve
Synovial sheath
Common palmar digital nerves
Branch of superficial branch of ulnar nerve to palmaris brevis (cut)
Abductor pollicis brevis
Abductor digiti minimi
Flexor retinaculum
Recurrent branch of median nerve
Superficial branch of ulnar nerve
Palmar branch of median nerve (cut)
Deep branches of ulnar artery and nerve
Superficial branch of radial artery
Palmar branch of ulnar nerve (cut)
Abductor pollicis longus tendon
Median nerve
Ulnar nerve
Palmaris longus tendon
Ulnar artery
Radial artery
Flexor carpi ulnaris tendon
Flexor carpi radialis

Plate 9.1 Superficial muscles, arteries, and nerves of the hand.

- Immediately after its passage through the carpal tunnel, the **median nerve** gives rise to several smaller branches: the recurrent branch of the median nerve and the common palmar digital branches. At this point in the dissection, identify the **common palmar digital branches of the median nerve** running alongside the common palmar digital arteries (Fig. 9.13, Plate 9.2).
- Continue the dissection toward the phalanges, and expose the separation of the common palmar digital branches of the median nerve into proper palmar digital nerves of the digits.
- Similarly, expose the site at which the common palmar digital arteries give rise to palmar digital arteries (Fig. 9.14).
- Clean away the fascia investing the **abductor and flexor digiti minimi muscles over the hypothenar region.**
- Continue the removal of fat and remnants of the palmar aponeurosis at the medial aspect of the palm, the *hypothenar eminence* (see Fig. 9.8). Identify the flexor digiti minimi and the abductor digiti minimi muscles (see Fig. 9.12). Expose the palmar digital branches to the 5th digit and medial half of the 4th digit (see Fig. 9.14).

DISSECTION **TIP**

The most superficially placed muscle in the hypothenar eminence is the *palmaris brevis*. This muscle is extremely thin and often blended with adipose tissue, arising from the palmar aponeurosis to insert into the skin. It is rather difficult to expose the palmaris brevis, because it is detached during removal of the palmar aponeurosis and skin.

DISSECTION **TIP**

In about 65% of hands, a communication between the ulnar and median nerves exists distal to the flexor retinaculum.

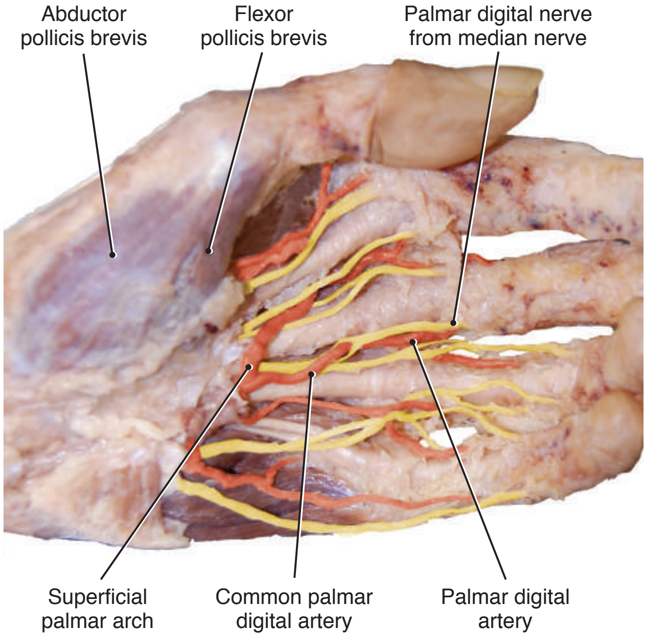

Abductor pollicis brevis
Flexor pollicis brevis
Palmar digital nerve from median nerve
Superficial palmar arch
Common palmar digital artery
Palmar digital artery

Fig. 9.13 Anterior view of hand with skin and aponeurosis reflected, highlighting tendon sheaths and neurovascular structures such as palmar digital nerves and arteries.

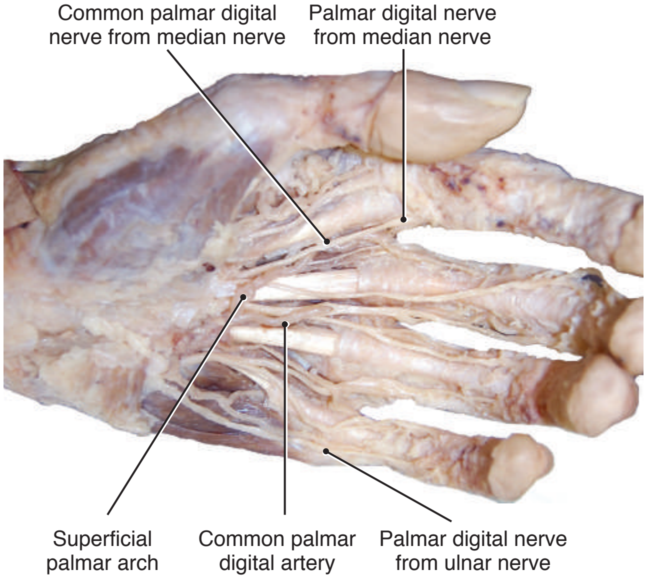

Common palmar digital nerve from median nerve
Palmar digital nerve from median nerve
Superficial palmar arch
Common palmar digital artery
Palmar digital nerve from ulnar nerve

Fig. 9.14 Anterior view of hand with skin and aponeurosis reflected, revealing tendon sheaths and neurovascular structures. Note common palmar arteries arising from superficial palmar arch.

○ **Trace the palmar digital branches to the 5th digit and medial half of the 4th digit toward their origin from the superficial branch of the ulnar nerve (Fig. 9.15).**

○ **Remove the deep fascia at the ulnar side of the wrist, and using scissors (Fig. 9.16), expose the superficial branch of the ulnar nerve (Fig. 9.17). The ulnar artery and nerve travel lateral to the pisiform bone to enter the palm.**

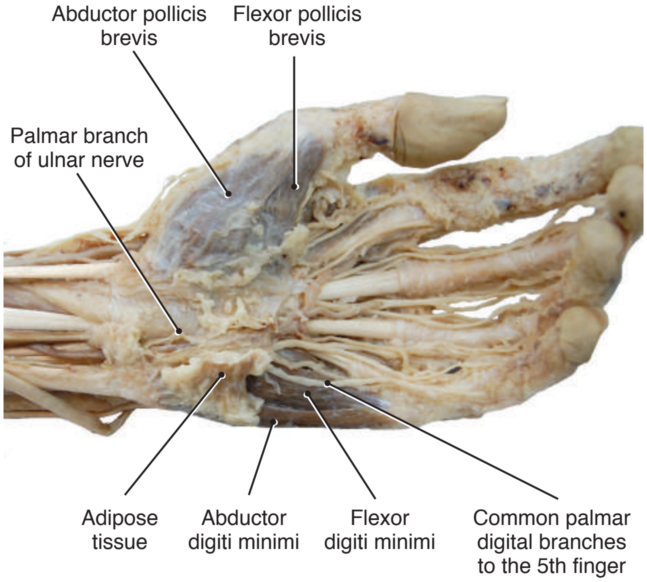
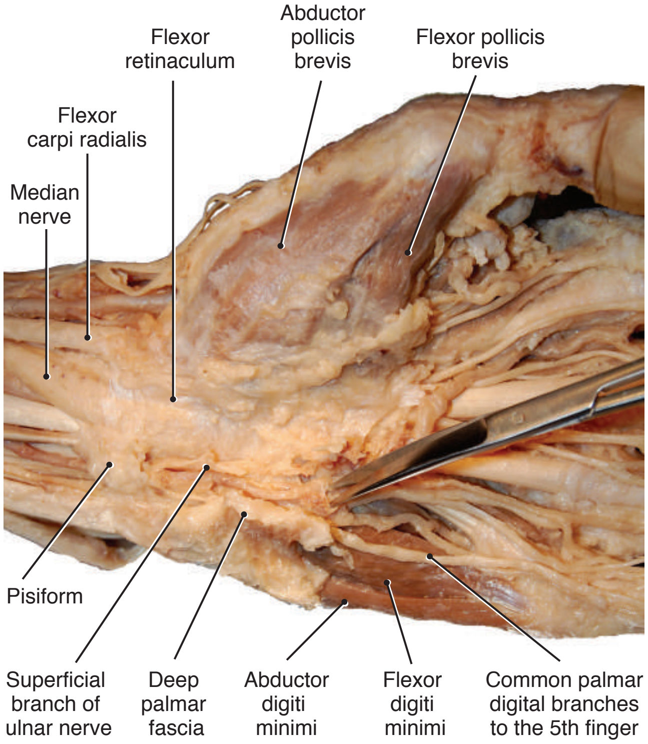

Abductor pollicis brevis
Flexor pollicis brevis
Palmar branch of ulnar nerve
Adipose tissue
Abductor digiti minimi
Flexor digiti minimi
Common palmar digital branches to the 5th finger

Fig. 9.15 Anterior hand with skin and aponeurosis reflected, revealing thenar and hypothenar muscles.


Flexor retinaculum
Abductor pollicis brevis
Flexor pollicis brevis
Flexor carpi radialis
Median nerve
Pisiform
Superficial branch of ulnar nerve
Deep palmar fascia
Abductor digiti minimi
Flexor digiti minimi
Common palmar digital branches to the 5th finger

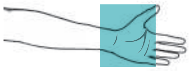


Fig. 9.16 Anterior hand with skin and aponeurosis reflected, revealing thenar and hypothenar muscles. Note median nerve traveling deep to flexor retinaculum within the carpal tunnel.

ANATOMY **NOTE**

This point is referred to as *Guyon's canal* (or tunnel) and is formed by the pisiform bone, the flexor retinaculum, and an extension of the deep fascia of the forearm (palmar carpal ligament).

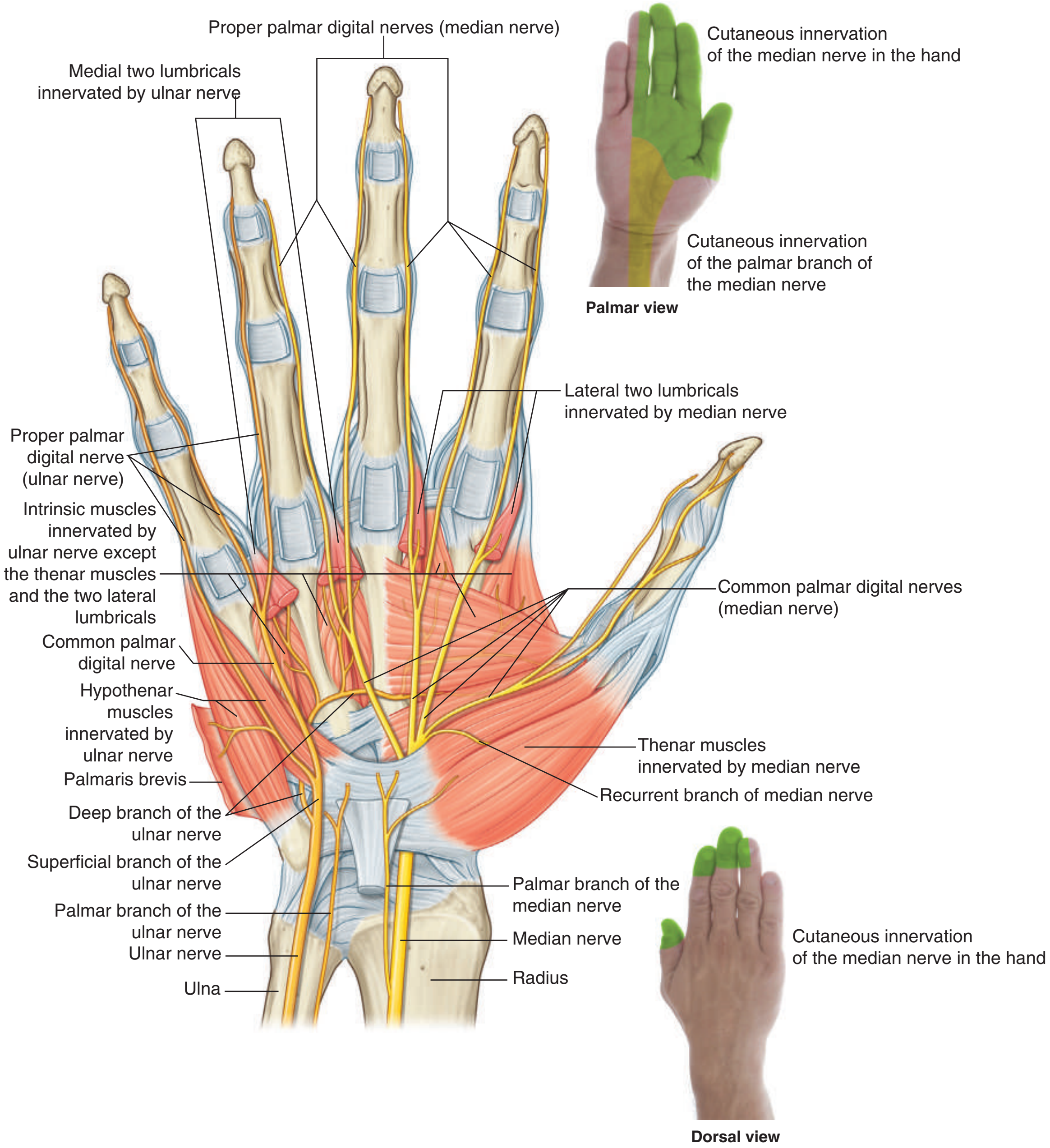

Proper palmar digital nerves (median nerve)
Medial two lumbricals innervated by ulnar nerve
Cutaneous innervation of the median nerve in the hand
Cutaneous innervation of the palmar branch of the median nerve
Palmar view
Lateral two lumbricals innervated by median nerve
Proper palmar digital nerve (ulnar nerve)
Intrinsic muscles innervated by ulnar nerve except the thenar muscles and the two lateral lumbricals
Common palmar digital nerves (median nerve)
Common palmar digital nerve
Hypothenar muscles innervated by ulnar nerve
Thenar muscles innervated by median nerve
Palmaris brevis
Recurrent branch of median nerve
Deep branch of the ulnar nerve
Superficial branch of the ulnar nerve
Palmar branch of the median nerve
Palmar branch of the ulnar nerve
Median nerve
Cutaneous innervation of the median nerve in the hand
Ulnar nerve
Radius
Ulna
Dorsal view

Plate 9.2 Innervation of the hand median and ulnar nerves.

- Expose the superficial ulnar artery and nerve toward the pisiform bone (Fig. 9.18).
- Clean the adipose tissue and remnants of the palmar aponeurosis surrounding the superficial palmar arch distally to the carpal tunnel and flexor retinaculum (see Fig. 9.18).

ANATOMY **NOTE**

The primary contributor to the superficial palmar arch is the ulnar artery.

- Expose the ulnar artery and clean the surface of the flexor retinaculum (Fig. 9.19).

DISSECTION **TIP**

The tendons of the flexor digitorum superficialis and flexor digitorum profundus muscles are enclosed by a synovial sheath, the *ulnar bursa.* The tendon of the flexor pollicis longus is also enclosed by a synovial sheath, the *radial bursa*.

- To free up the superficial palmar arch and nerve structures from the underlying long flexor tendons, use scissors to incise the fibrous tendinous sheaths longitudinally. Identify tendons of flexor digitorum superficialis and profundus muscles (Fig. 9.20).

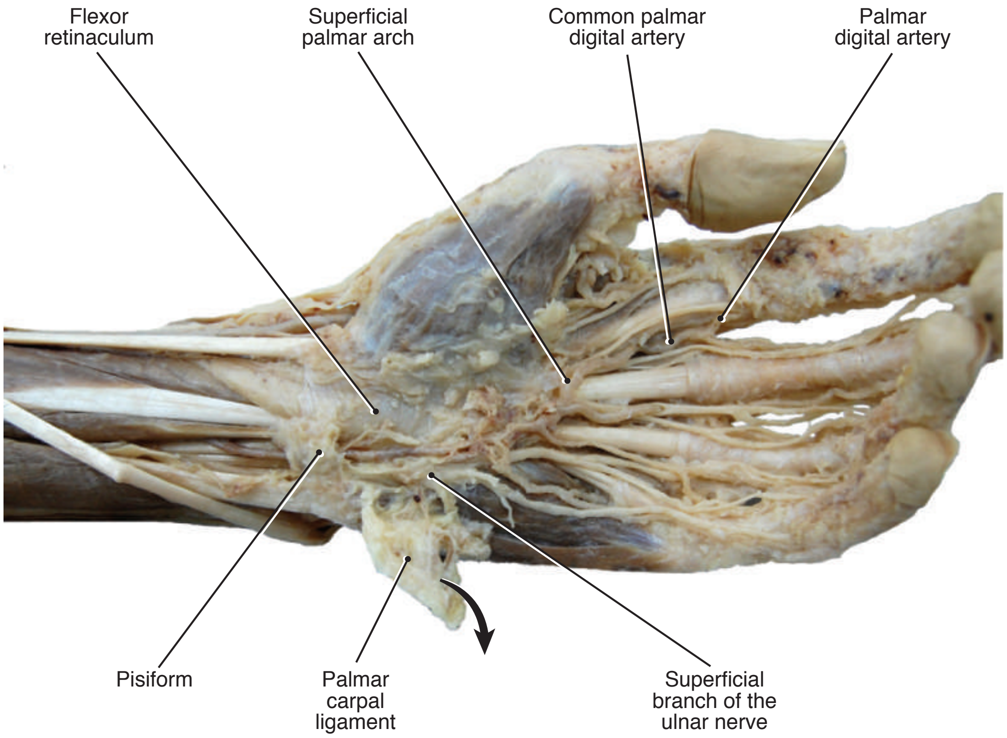

Flexor retinaculum
Superficial palmar arch
Common palmar digital artery
Palmar digital artery
Pisiform
Palmar carpal ligament
Superficial branch of the ulnar nerve

Fig. 9.17 Anterior hand with skin and aponeurosis reflected, revealing thenar and hypothenar muscles. Note the palmar carpal ligament that has been reflected to better illustrate the deeper flexor retinaculum.

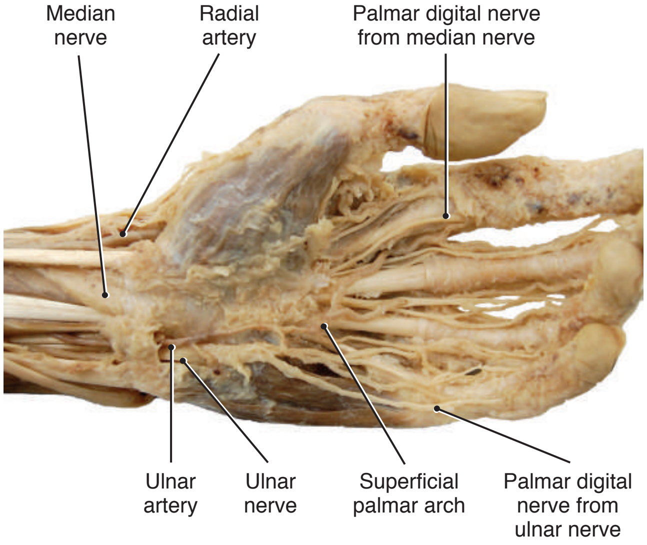

Median nerve
Radial artery
Palmar digital nerve from median nerve
Ulnar artery
Ulnar nerve
Superficial palmar arch
Palmar digital nerve from ulnar nerve

Fig. 9.18 Anterior hand with skin and aponeurosis removed, revealing superficial palmar arch.

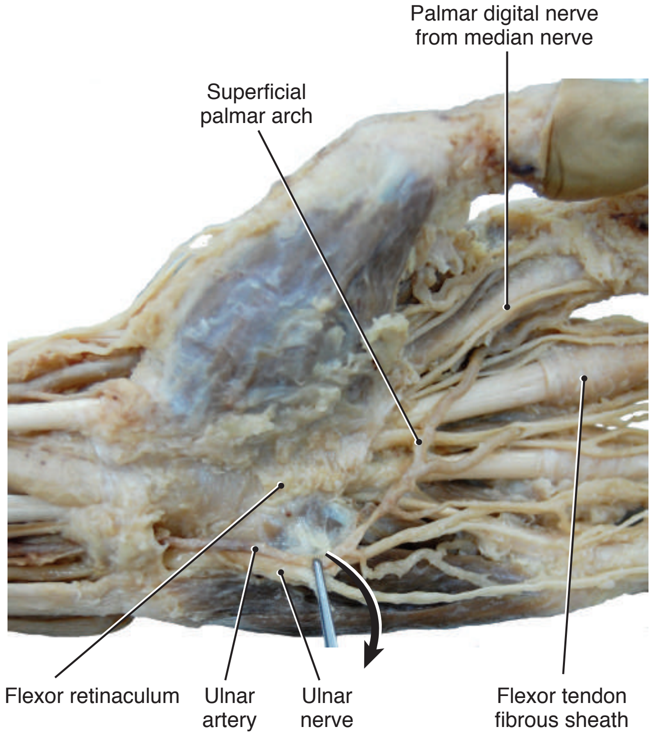
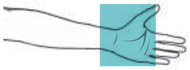
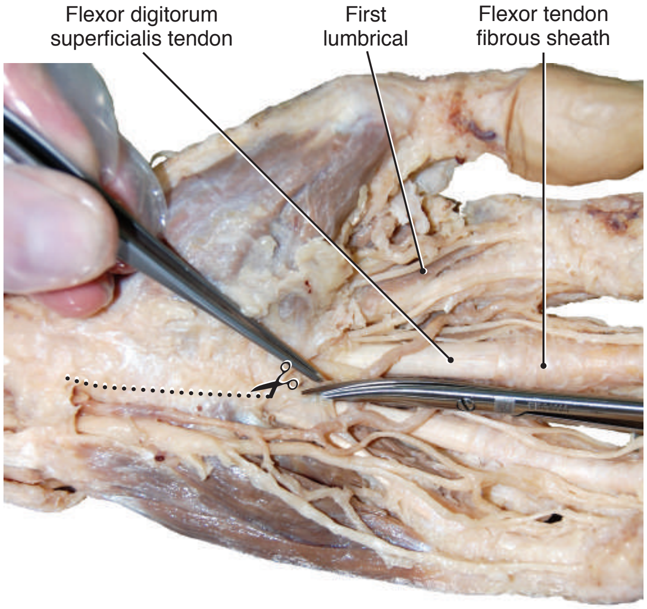

Palmar digital nerve from median nerve
Superficial palmar arch
Flexor retinaculum
Ulnar artery
Ulnar nerve
Flexor tendon fibrous sheath

Fig. 9.19 Anterior hand with skin and aponeurosis removed, revealing superficial palmar arterial arch and branches to the digits.




Flexor digitorum superficialis tendon
First lumbrical
Flexor tendon fibrous sheath

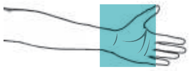


Fig. 9.20 Anterior hand with skin and aponeurosis removed. Use scissors to open the fibrous tendon sheaths to identify tendons of flexor digitorum superficialis and profundus muscles.

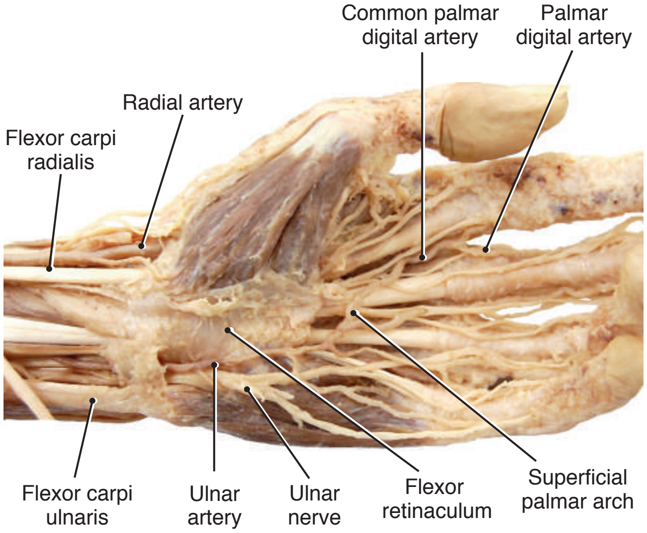

Common palmar digital artery
Palmar digital artery
Radial artery
Flexor carpi radialis
Flexor carpi ulnaris
Ulnar artery
Ulnar nerve
Flexor retinaculum
Superficial palmar arch

Fig. 9.21 Anterior hand with skin and aponeurosis removed, revealing digital arteries and nerves and superficial branches of ulnar nerve and artery (superficial palmar arch).

- Immediately distal to the pisiform bone and lateral to the flexor retinaculum, expose the division of the ulnar artery and nerve into deep and superficial branches (Fig. 9.21).
- The deep branches dive deeply between the abductor and flexor digiti minimi muscles of the 5th digit.

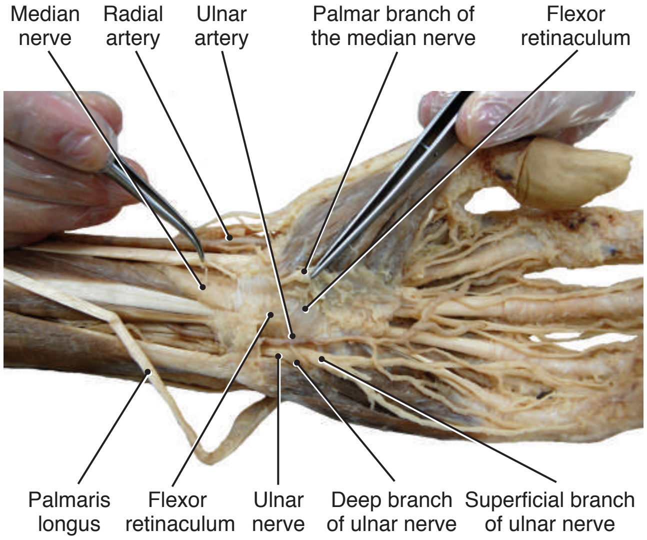

Median nerve
Radial artery
Ulnar artery
Palmar branch of the median nerve
Flexor retinaculum
Palmaris longus
Flexor retinaculum
Ulnar nerve
Deep branch of ulnar nerve
Superficial branch of ulnar nerve

Fig. 9.22 Anterior hand with skin and aponeurosis removed, revealing palmar cutaneous branch of median nerve, which passes superficial to the flexor retinaculum to supply skin over the thenar eminence.

DISSECTION **TIP**

The palmar cutaneous branch of the median nerve is often cut during routine dissection. The median nerve is seen at the distal forearm between the tendons of the palmaris longus and flexor carpi radialis and supplies the skin over the central portion of the palm.

ANATOMY **NOTE**

The *flexor retinaculum* is a dense connective tissue band that helps create a tunnel *(carpal tunnel)* for the tendons of the flexor digitorum superficialis, flexor digitorum profundus, flexor pollicis longus, and the median nerve to reach the palm.

- Carefully expose the flexor retinaculum and identify its borders. Look for the palmar cutaneous branch of the median nerve (Fig. 9.22).
- Pass a probe or scissors underneath the flexor retinaculum in the carpal tunnel (Fig. 9.23).
- Leave the probe within the carpal tunnel and with scissors divide the flexor retinaculum on top of the probe (Fig. 9.24). This retinaculum is transected by inserting the scissors into the carpal tunnel upwardly, cutting in a proximal-to-distal manner.
- Remove the probe, and retract the flexor retinaculum to expose the median nerve and tendons of the flexor digitorum superficialis (Figs. 9.25 and 9.26).
- Remove the connective tissue sheath over the median nerve and the underlying flexor digitorum superficialis muscle (Fig. 9.27).

- **Continue exposing the median nerve within the carpal tunnel. Identify the recurrent branch of the median nerve (Fig. 9.28). Finish the exposure of the common palmar digital branches of the median nerve.**

DISSECTION TIP

The recurrent branch of the median nerve usually travels deep to the thenar muscles, and tracing its course anteriorly may be difficult. In such cases, gently retract the median nerve (within exposed carpal tunnel) laterally, and identify the recurrent branch of the median nerve. You also may dissect between the flexor pollicis brevis and the underlying adductor pollicis muscle to trace the recurrent branch of the median nerve.

DISSECTION TIP

In some cases, branches of the superficial palmar arch travel close to the common palmar digital branches or penetrate them. Use special care when you dissect these structures (Fig. 9.29).

- **With forceps, retract the abductor digiti minimi muscle laterally, and expose the flexor digiti minimi brevis and the opponens digiti minimi muscles (Fig. 9.30).**
- **You may cut and reflect the abductor digiti minimi near its origin to expose the underlying opponens digiti minimi muscle.**

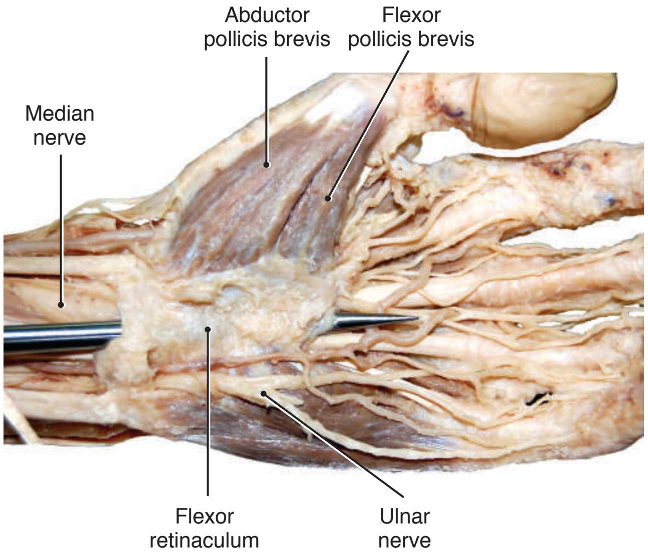

Abductor pollicis brevis
Flexor pollicis brevis
Median nerve
Flexor retinaculum
Ulnar nerve

Fig. 9.23 Anterior hand with removed skin and aponeurosis showing flexor retinaculum. Note that the ulnar nerve and artery travel superficial to the flexor retinaculum but deep to the palmar carpal ligament.

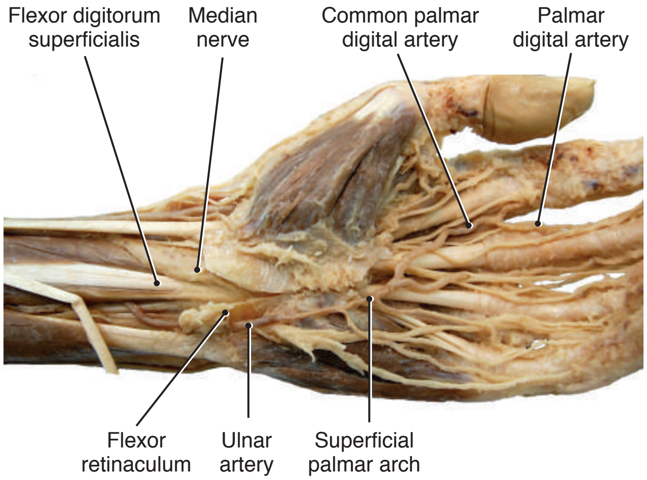

Flexor digitorum superficialis
Median nerve
Common palmar digital artery
Palmar digital artery
Flexor retinaculum
Ulnar artery
Superficial palmar arch

Fig. 9.25 Anterior hand with transection of the flexor retinaculum. Deeper dissection will reveal the nine tendons and one nerve that course through the carpal tunnel.

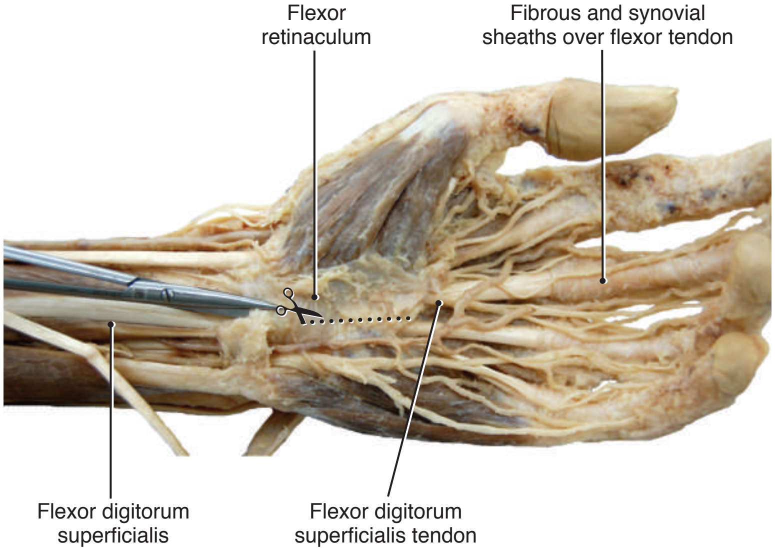

Flexor retinaculum
Fibrous and synovial sheaths over flexor tendon
Flexor digitorum superficialis
Flexor digitorum superficialis tendon

Fig. 9.24 Anterior hand with removed skin and aponeurosis revealing the flexor retinaculum.

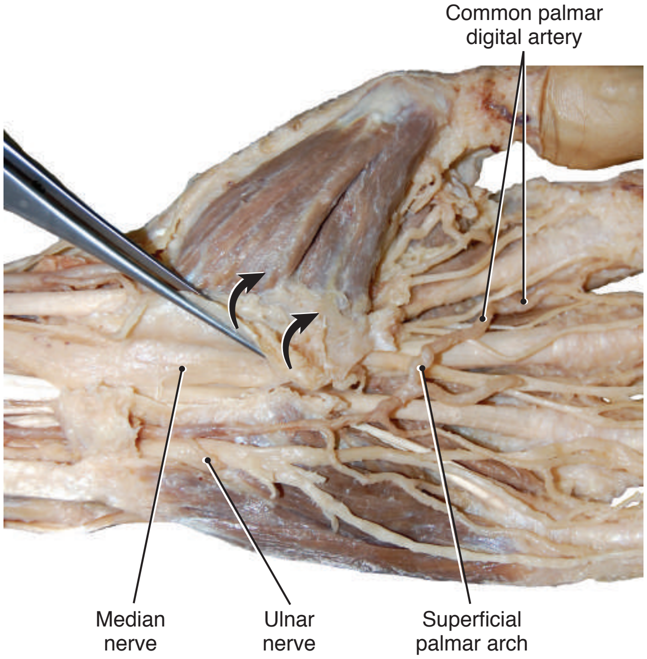

Common palmar digital artery
Median nerve
Ulnar nerve
Superficial palmar arch

Fig. 9.26 Anterior hand with flexor retinaculum reflected. Median nerve can be traced from distal forearm to the hand through exposed carpal tunnel. Distal to the flexor retinaculum, note branching pattern of the median nerve.

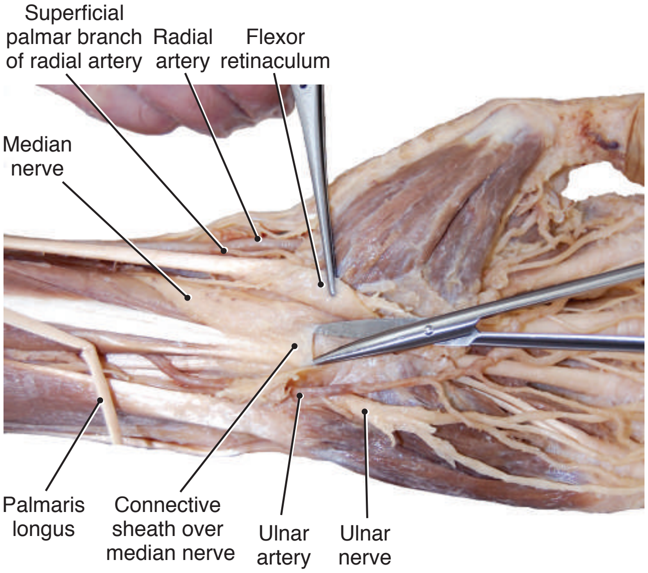

Superficial palmar branch of radial artery
Radial artery
Flexor retinaculum
Median nerve
Palmaris longus
Connective sheath over median nerve
Ulnar artery
Ulnar nerve

Fig. 9.27 Anterior view of hand after transection of the flexor retinaculum, revealing the carpal tunnel.

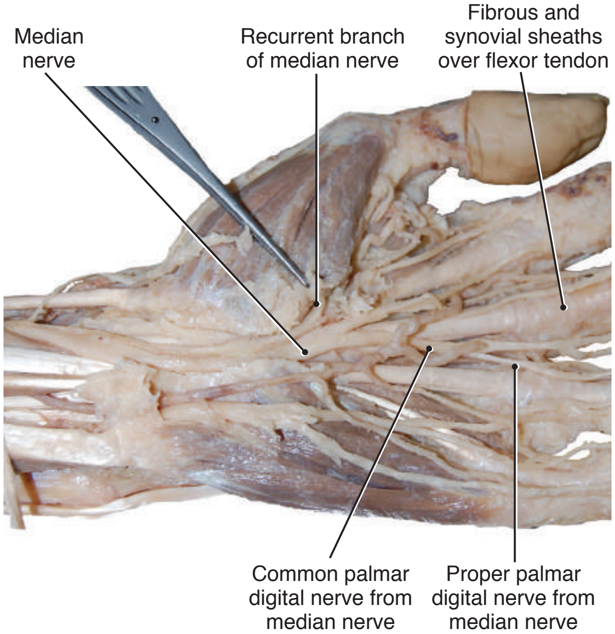

Median nerve
Recurrent branch of median nerve
Fibrous and synovial sheaths over flexor tendon
Common palmar digital nerve from median nerve
Proper palmar digital nerve from median nerve

Fig. 9.28 Anterior hand with cut flexor retinaculum revealing the carpal tunnel. The median nerve can be traced through the tunnel and its recurrent branch identified near the distal end of the flexor retinaculum.

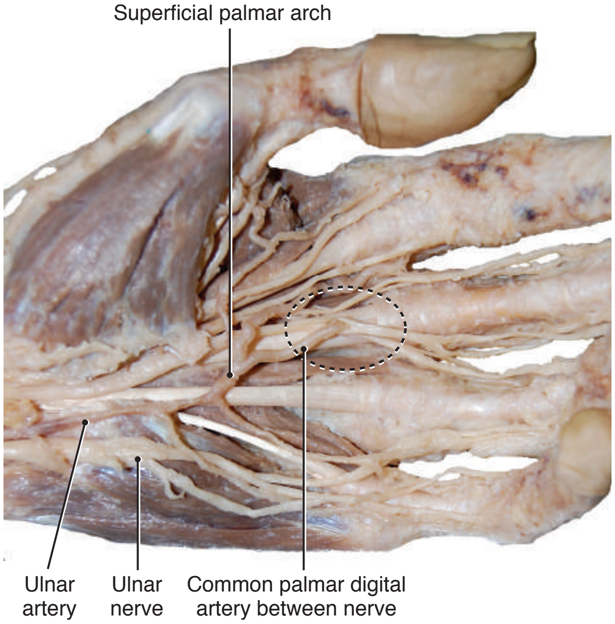

Superficial palmar arch
Ulnar artery
Ulnar nerve
Common palmar digital artery between nerve

Fig. 9.29 Anterior hand with removed aponeurosis, cut flexor retinaculum, and opened carpal tunnel. Note relationship between common palmar digital arteries and nerves *(circled).*

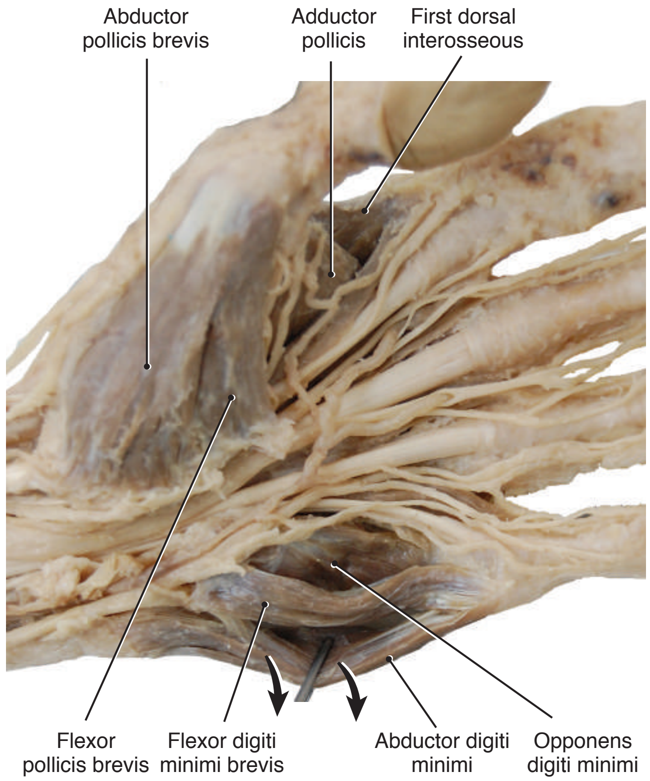
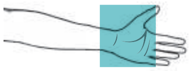

Abductor pollicis brevis
Adductor pollicis
First dorsal interosseous
Flexor pollicis brevis
Flexor digiti minimi brevis
Abductor digiti minimi
Opponens digiti minimi

Fig. 9.30 Anterior hand with removed skin and aponeurosis and cut flexor retinaculum revealing carpal tunnel. With separation, muscular components of hypothenar eminence are seen.



DISSECTION TIP

In the majority of the specimens, the flexor digiti minimi muscle is difficult to separate from the abductor digiti minimi muscle. Follow the deep branch of the ulnar nerve to the hypothenar muscles. This nerve runs between the flexor digiti minimi and abductor digiti minimi muscles, facilitating their identification. The deepest of the hypothenar muscles is the opponens digiti minimi muscle.

- **Trace the superficial palmar arch laterally in the space between the 1st digit and the 2nd digit.**

DISSECTION TIP

There is usually an anastomosis between the superficial palmar arch and a branch of the radial artery, the *radialis indicis,* and a branch to the 1st digit, the *princeps pollicis* (Fig. 9.31).

- **Identify the *abductor pollicis brevis muscle,* lying at the lateral side of the base of the 1st phalanx of the 1st digit (see Fig. 9.31).**
- **Medial and next to the abductor pollicis brevis muscle, identify the flexor pollicis brevis muscle, which is passing along the radial side of the tendon of the flexor pollicis longus muscle. Retract the abductor pollicis brevis muscle laterally from the flexor pollicis brevis muscle, and identify the opponens pollicis muscle (Fig. 9.32). Flexor pollicis brevis has two heads. Its deep head can be mistaken for the opponens pollicis brevis. Reflect both heads.**
- **Finally, identify the adductor pollicis muscle, which can be seen between the base of the 2nd and 1st digits.**

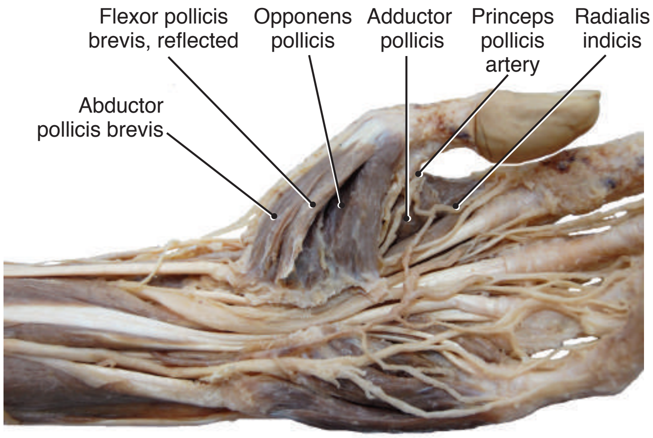

Flexor pollicis brevis, reflected
Opponens pollicis
Adductor pollicis
Princeps pollicis artery
Radialis indicis
Abductor pollicis brevis

Fig. 9.31 Anterior hand with removed skin and aponeurosis and cut flexor retinaculum revealing carpal tunnel. With separation, muscles of the thenar eminence are seen.

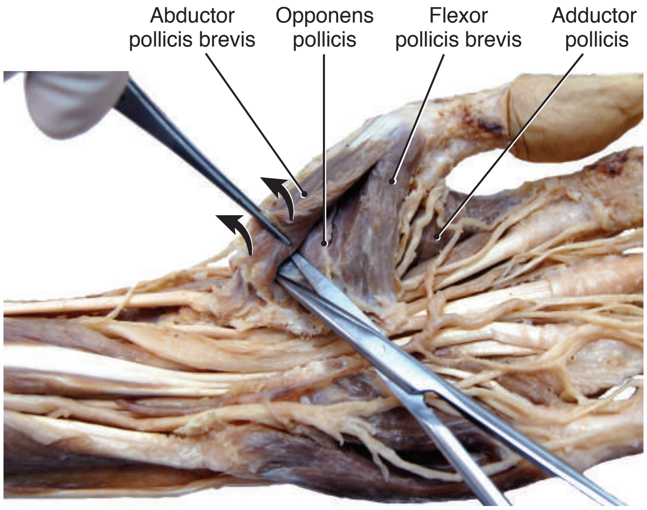

Abductor pollicis brevis
Opponens pollicis
Flexor pollicis brevis
Adductor pollicis

Fig. 9.32 Anterior hand with skin and aponeurosis removed and flexor reticulum cut revealing thenar muscles. Scissors are used to transect the origin of the abductor pollicis brevis muscle.

DISSECTION TIP

You may also transect the abductor pollicis brevis and identify the opponens pollicis muscle just underneath it (Fig. 9.33). Another way to distinguish the opponens pollicis brevis muscle from the abductor pollicis brevis and the flexor pollicis muscles is its insertion point. The opponens pollicis brevis muscle inserts alongside the 1st metacarpal.

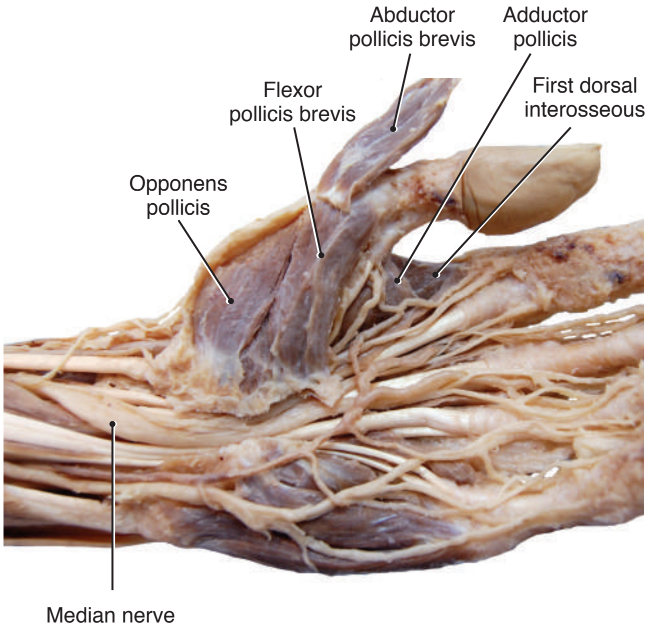

Abductor pollicis brevis
Adductor pollicis
Flexor pollicis brevis
First dorsal interosseous
Opponens pollicis
Median nerve

Fig. 9.33 Anterior hand with skin and aponeurosis removed and flexor reticulum cut revealing thenar structures. With abductor pollicis brevis reflected, the deeper-lying opponens pollicis is visualized.

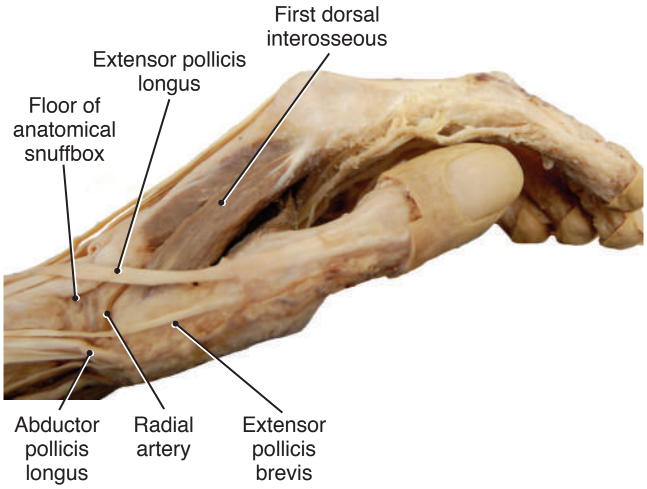

First dorsal interosseous
Extensor pollicis longus
Floor of anatomical snuffbox
Abductor pollicis longus
Radial artery
Extensor pollicis brevis

Fig. 9.34 Region of "anatomic snuffbox," with borders and contents, including radial artery. Note 1st dorsal interosseous muscle between 1st and 2nd digits.

- On the dorsum of the hand, clean and expose the tendinous insertions of abductor pollicis longus, the extensor pollicis brevis, and the extensor pollicis longus (Fig. 9.34).

ANATOMY **NOTE**

The tendons of these three muscles (abductor pollicis longus, the extensor pollicis brevis, and the extensor pollicis longus) form the boundaries of the anatomic snuffbox, through which the radial artery passes to reach the dorsum of the 1st digit.

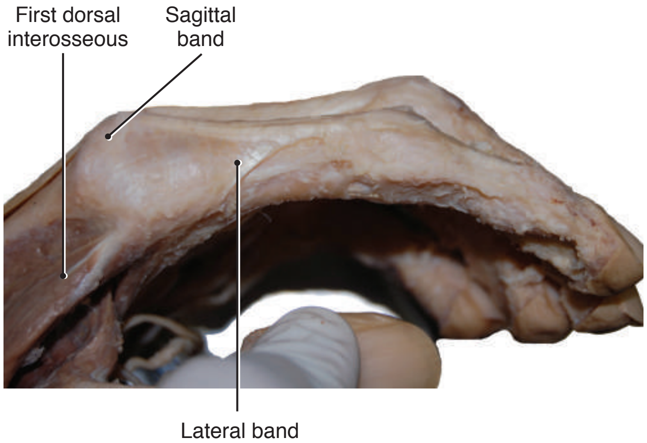

First dorsal interosseous
Sagittal band
Lateral band

Fig. 9.35 Dorsal view of 1st and 2nd digits with skin removed, revealing superficial structures. Note components of dorsal expansion, including sagittal and lateral bands.

DORSAL HAND

- Identify the radial artery and trace it as it passes between the two heads of the 1st dorsal interosseous muscle (see Fig. 9.34).
- Observe the radial side of the 2nd digit. At the level of the proximal interphalangeal joint, note the extensor mechanism splitting into three parts. Note that one of these parts, the lateral bands, to which the extensor tendons contribute, eventually unite with the transverse metacarpal ligament (Fig. 9.35).
- At the palmar side of the digits, observe the fibrous synovial sheaths surrounding the tendons of the long flexor muscles (Fig. 9.36).

DISSECTION **TIP**

These fibrous sheaths are thin at the interphalangeal joints (cruciate fibers) and thick over the phalanges (anular fibers/ligament).

RETURN TO PALMAR HAND AND ANTERIOR FOREARM

- With a scalpel, cut at the midline the fibrous synovial sheath, and expose the tendon of the flexor digitorum superficialis and flexor digitorum profundus (Figs. 9.37 and 9.38).
- Extend the distal interphalangeal joint. Observe the tendon of the flexor digitorum superficialis dividing before inserting at the base of the middle phalanx. In addition, the tendon of the flexor digitorum profundus passes through the divided tendon of the flexor digitorum superficialis to insert onto the distal phalanges (Figs. 9.39 and 9.40). Note the vinculum longum,

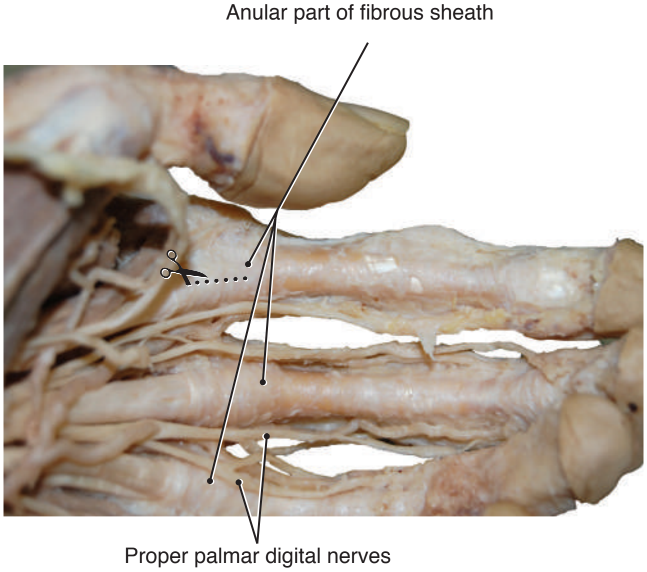

Anular part of fibrous sheath
Proper palmar digital nerves

Fig. 9.36 Anterior view of palm illustrating fibrous digital sheaths and related structures (e.g., palmar digital nerves).

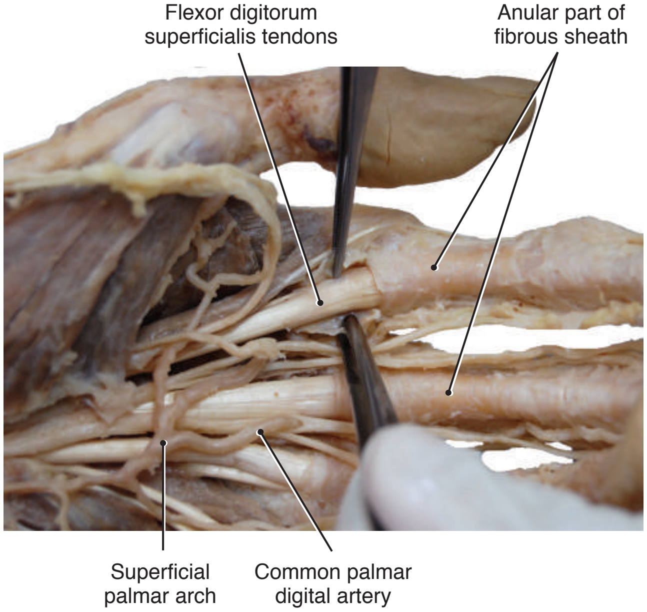

Flexor digitorum superficialis tendons
Anular part of fibrous sheath
Superficial palmar arch
Common palmar digital artery

Fig. 9.37 Anterior view of palm after partial opening of flexor digital sheaths of the 2nd and 3rd digits. Note anular components of fibrous sheaths and internally located flexor tendons.

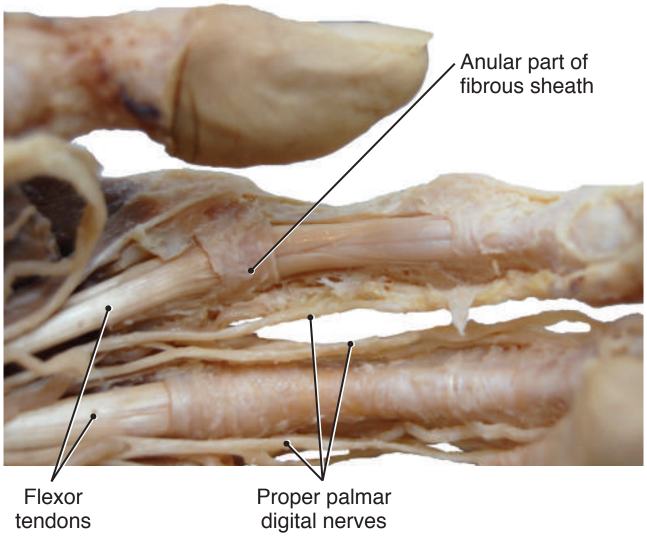

Anular part of fibrous sheath
Flexor tendons
Proper palmar digital nerves

Fig. 9.38 Anterior view of 1st to 3rd digits. Note anular component of fibrous digital sheath and deeper-lying flexor tendons.

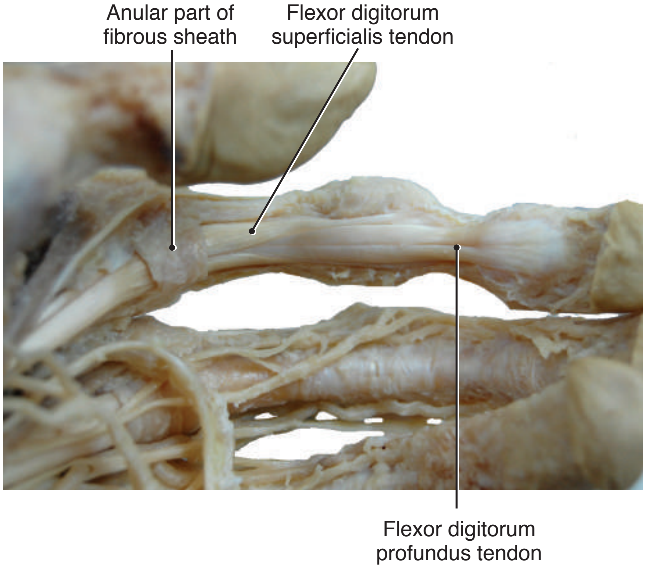

Anular part of fibrous sheath
Flexor digitorum superficialis tendon
Flexor digitorum profundus tendon

Fig. 9.39 Anterior view of 1st to 4th digits with portions of fibrous digital sheaths removed. Note the deeper-lying flexor tendons of flexor digitorum superficialis and profundus muscles.

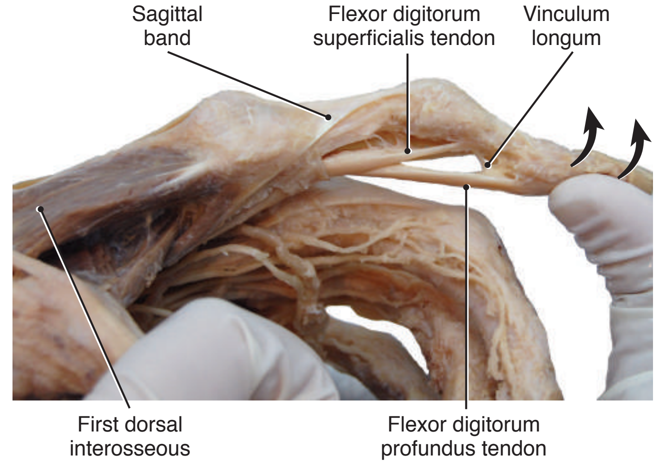

Sagittal band
Flexor digitorum superficialis tendon
Vinculum longum
First dorsal interosseous
Flexor digitorum profundus tendon

Fig. 9.40 Lateral view of interspace between 1st and 2nd digits. Note the flexor digitorum profundus tendon passing through the split tendon of flexor digitorum superficialis muscle.

a thin ligament that adds support for the attachments of the flexor digitorum superficialis and flexor digitorum profundus.

- **Once all muscles, nerves, and arteries of the hand have been identified (Fig. 9.41), pass a probe or a pair of scissors underneath the flexor digitorum superficialis tendons (Fig. 9.42), and transect them at the level of the carpal tunnel (Fig. 9.43).**
- **Lift the flexor digitorum superficialis and expose the median nerve. Clean the median nerve and its surrounding muscles from any loose connective tissue (Figs. 9.44 and 9.45).**
- **Transect the median, ulnar, and radial nerves, as well as the ulnar artery at the same level (Fig. 9.46).**
- **Retract the neurovascular bundles distally to expose the tendons of the flexor digitorum superficialis. Lift the tendons of the flexor digitorum superficialis and expose all four lumbrical muscles (Fig. 9.47).**

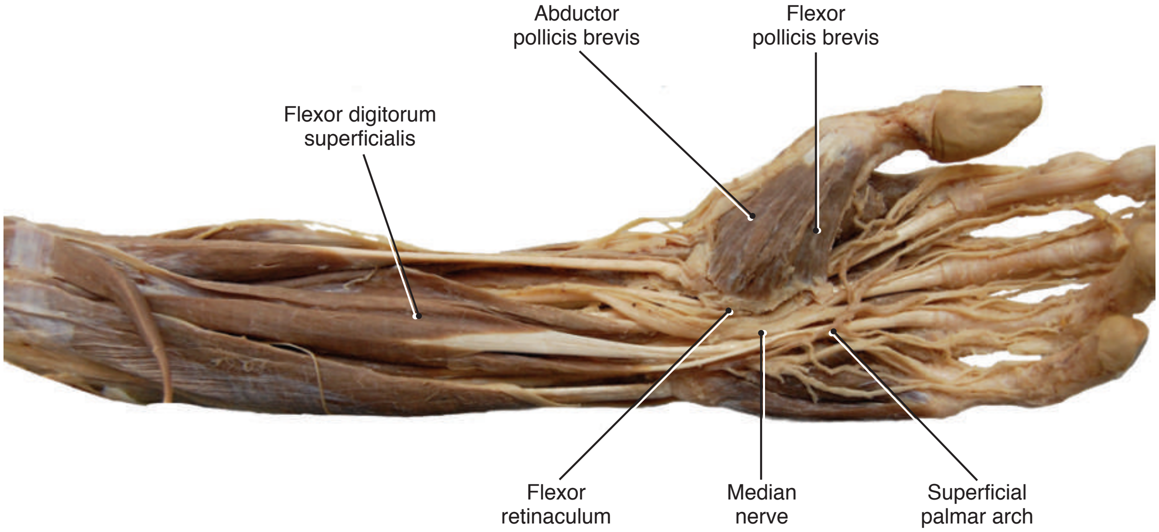

Abductor pollicis brevis
Flexor pollicis brevis
Flexor digitorum superficialis
Flexor retinaculum
Median nerve
Superficial palmar arch

Fig. 9.41 Anterior forearm and hand view with aponeurosis removed, revealing superficial and intermediate musculature.

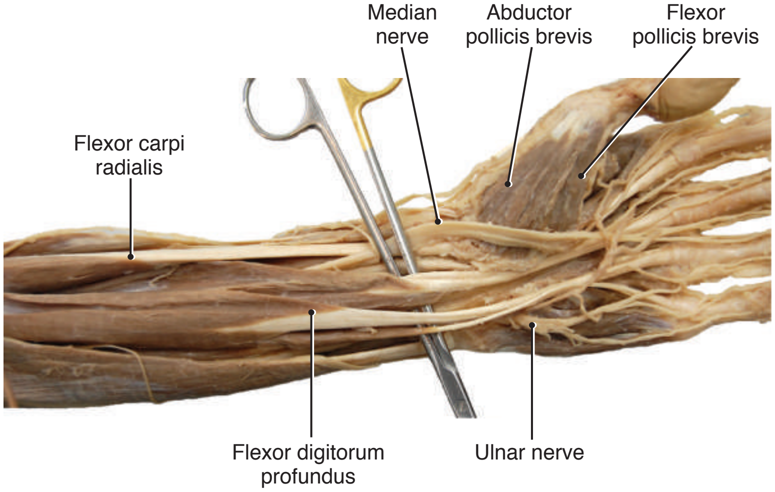

Median nerve
Abductor pollicis brevis
Flexor pollicis brevis
Flexor carpi radialis
Flexor digitorum profundus
Ulnar nerve

Fig. 9.42 Anterior view of forearm and hand with aponeurosis removed, revealing superficial and intermediate musculature. The median nerve is pulled from between flexor digitorum superficialis and profundus muscles; these muscles are pulled forward and scissors placed deep to them.

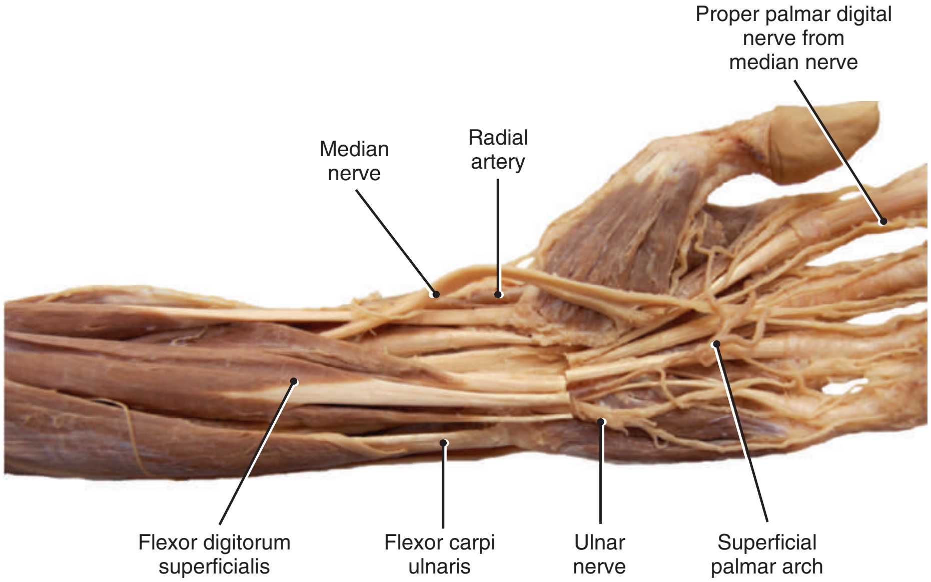

Proper palmar digital nerve from median nerve
Median nerve
Radial artery
Flexor digitorum superficialis
Flexor carpi ulnaris
Ulnar nerve
Superficial palmar arch

Fig. 9.43 Anterior forearm and hand with skin and aponeurosis removed; superficial and intermediate muscles are cut at the wrist. The median nerve is retracted.

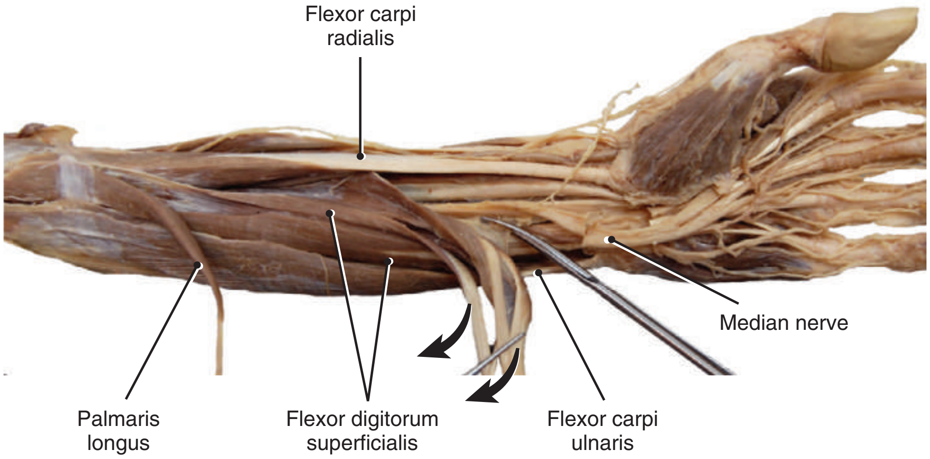

Flexor carpi radialis
Median nerve
Palmaris longus
Flexor digitorum superficialis
Flexor carpi ulnaris

Fig. 9.44 Anterior forearm and hand with skin and aponeurosis removed and superficial and intermediate muscles reflected, revealing neurovascular structures.

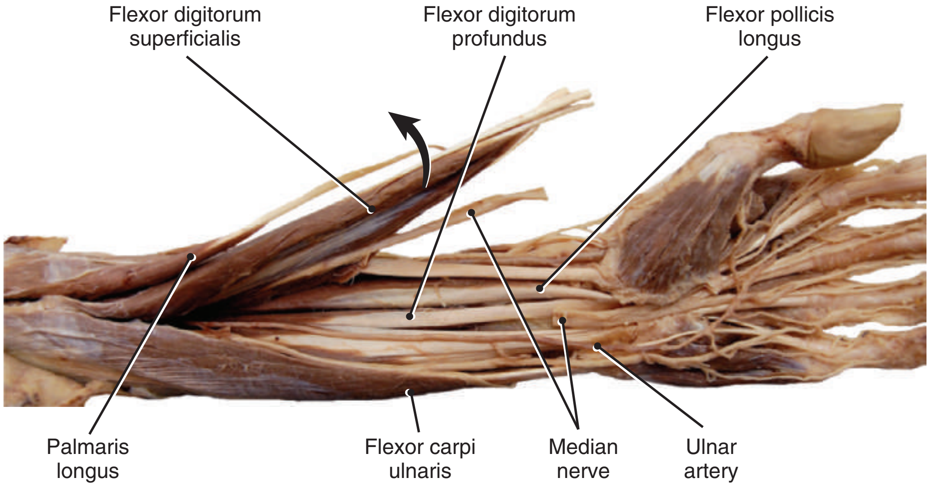

Flexor digitorum superficialis
Flexor digitorum profundus
Flexor pollicis longus
Palmaris longus
Flexor carpi ulnaris
Median nerve
Ulnar artery

Fig. 9.45 Anterior hand with skin and aponeurosis removed and flexor retinaculum cut, revealing tendons and muscles. The median nerve has been transected in the distal forearm.

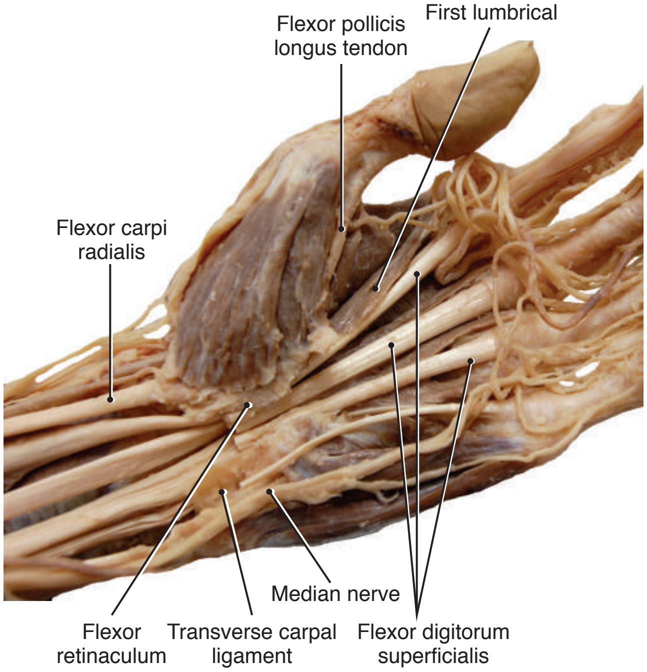

Flexor pollicis longus tendon
First lumbrical
Flexor carpi radialis
Median nerve
Flexor retinaculum
Transverse carpal ligament
Flexor digitorum superficialis

Fig. 9.46 Anterior hand with skin and aponeurosis removed and flexor retinaculum cut, revealing tendons and muscles. Flexor pollicis longus tendon is exposed, and superficial neurovascular structures are reflected distally.

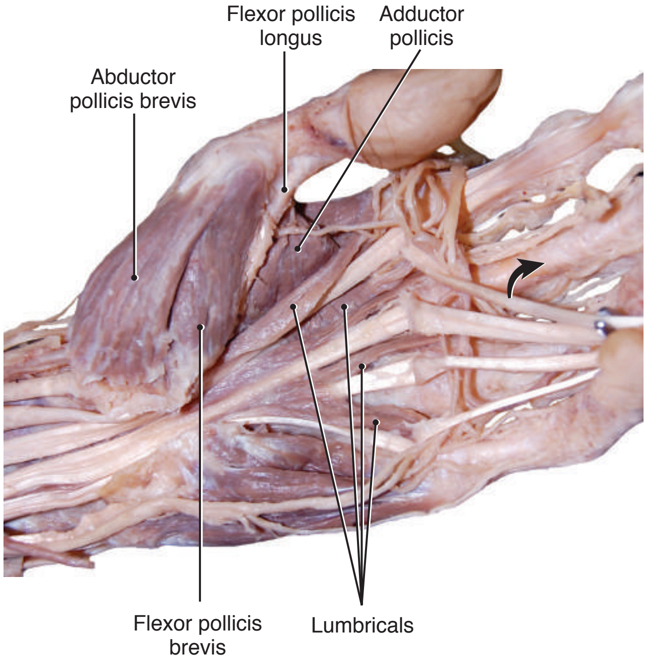

Flexor pollicis longus
Adductor pollicis
Abductor pollicis brevis
Flexor pollicis brevis
Lumbricals

Fig. 9.47 Anterior hand with skin and aponeurosis removed, revealing deeper muscles (e.g., adductor pollicis, lumbricals).

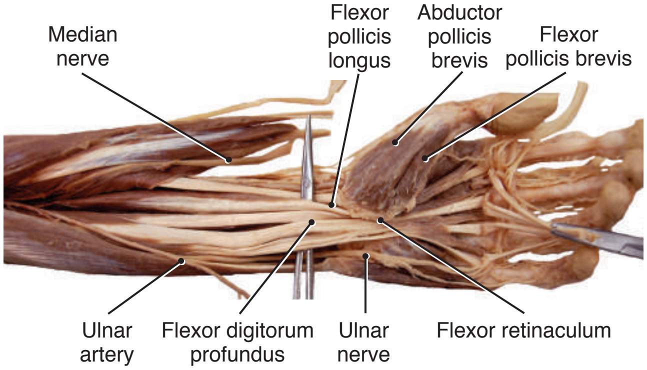

Median nerve
Flexor pollicis longus
Abductor pollicis brevis
Flexor pollicis brevis
Ulnar artery
Flexor digitorum profundus
Ulnar nerve
Flexor retinaculum

Fig. 9.48 Anterior forearm and hand with skin and aponeurosis removed; superficial and intermediate muscles reflected, revealing deep muscles. Tendon of flexor pollicis longus can be seen entering and exiting carpal tunnel. Scissors placed deep to nine tendons that travel through the carpal tunnel.

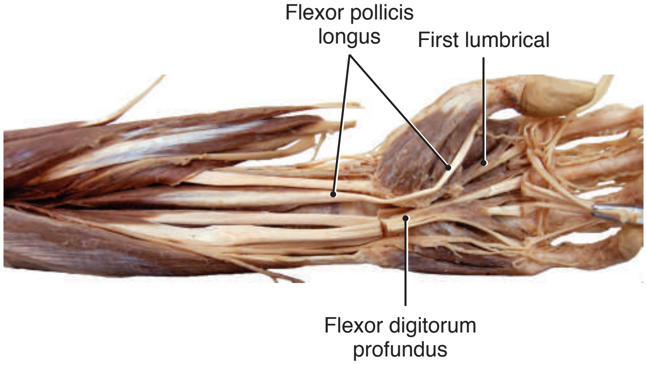

Flexor pollicis longus
First lumbrical
Flexor digitorum profundus

Fig. 9.49 Anterior view of hand and wrist with skin and aponeurosis removed and flexor retinaculum cut, revealing carpal tunnel tendons.

- **Clamp the tendons of the flexor digitorum superficialis with a hemostat and retract the tendons distally.**
- **Pass a probe or scissors underneath the flexor digitorum profundus (Fig. 9.48) and transect it at the level of the carpal tunnel (Fig. 9.49).**
- **Lift this part of the flexor digitorum profundus within the palm, and separate it from the underlying structures with scissors (Fig. 9.50).**
- **Identify the adductor pollicis muscle, and at the center of the palm, observe the loose connective tissue covering the underlying structures (Fig. 9.51).**
- **With sharp scissors, clean the connective tissue, and expose the deep palmar arch and the deep branch of the ulnar nerve (Fig. 9.52).**

ANATOMY **NOTE**

The lumbricals arise from the tendons of the flexor digitorum profundus muscle and travel to the radial side of the medial four digits to insert into the extensor expansion of each digit.

ANATOMY **NOTE**

The radial artery enters the deep portion of the hand between the two heads of the first dorsal interosseous muscle and anastomoses with the deep branch of the ulnar artery.

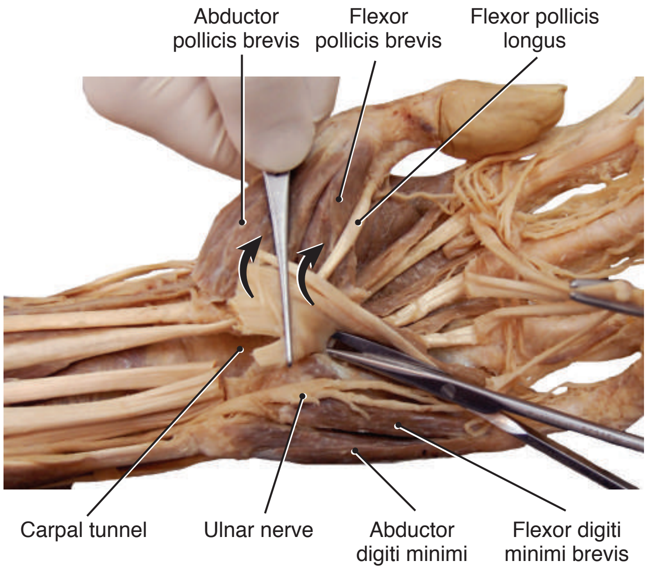

Abductor pollicis brevis
Flexor pollicis brevis
Flexor pollicis longus
Carpal tunnel
Ulnar nerve
Abductor digiti minimi
Flexor digiti minimi brevis

Fig. 9.50 Anterior hand with skin and aponeurosis removed; superficial and deep tendons cut and reflected, revealing carpal tunnel and its contents. Tendons of flexor digitorum superficialis and profundus are cut and reflected.

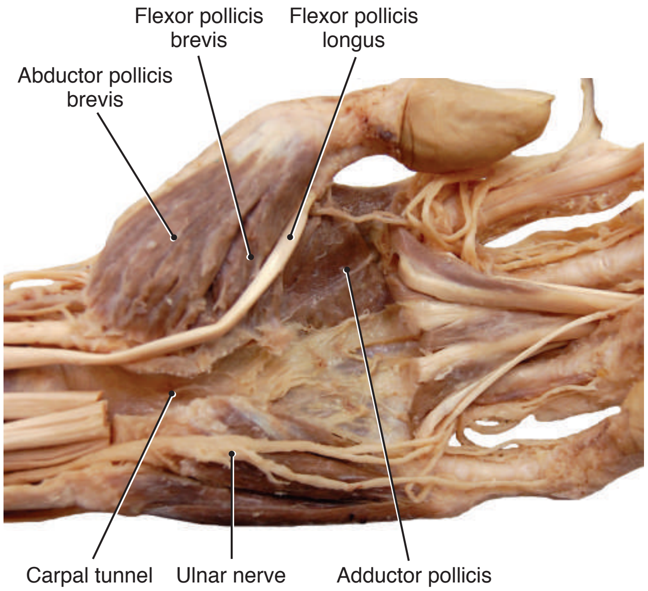

Flexor pollicis brevis
Flexor pollicis longus
Abductor pollicis brevis
Carpal tunnel
Ulnar nerve
Adductor pollicis

Fig. 9.51 Anterior hand with skin and aponeurosis removed; tendons reflected from carpal tunnel revealing thenar and palmar muscles.

○ **Continue exposing the deep palmar arch and the ulnar nerve and identify the interossei muscles. Identify four dorsal and three palmar interossei muscles (Fig. 9.53).**

○ **Reflect the flexor digitorum profundus and superficialis, and note the pronator quadratus muscle. This muscle requires no dissection (Fig. 9.54).**

○ **At the end of the dissection, place all structures back in their original anatomic position (Fig. 9.55). By following this dissection technique, you will be able to examine the specimen with all the structures in their original position.**

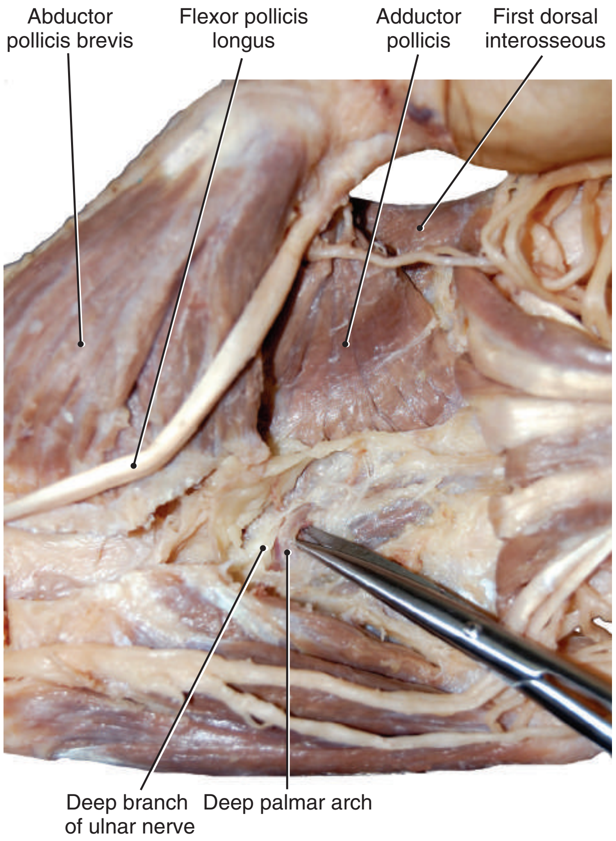
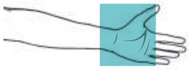

Abductor pollicis brevis
Flexor pollicis longus
Adductor pollicis
First dorsal interosseous
Deep branch of ulnar nerve
Deep palmar arch

Fig. 9.52 Anterior hand with skin and aponeurosis removed; tendons cut and reflected to reveal the deep palmar arch, with its blood flow contributed to primarily by the radial artery.



DISSECTION **TIP**

The dorsal and palmar interossei muscles insert partially on the base of the 1st phalanx of each of the medial four digits and into their extensor expansions:

- 1st dorsal interosseous muscle inserts on radial side of 2nd digit.
- 2nd and 3rd dorsal interossei insert on either side of 3rd digit.
- 4th dorsal interosseous muscle inserts on ulnar side of 4th digit.
- 1st palmar interosseous muscle inserts on ulnar side of 2nd digit.
- 2nd palmar interosseous muscle inserts on radial side of 4th digit.
- 3rd palmar interosseous muscle inserts on radial side of 5th digit.

DISSECTION **TIP**

The palmar fascial spaces are **potential spaces**, which are clinically important as routes of infection spread. These are not dissected in routine dissection.

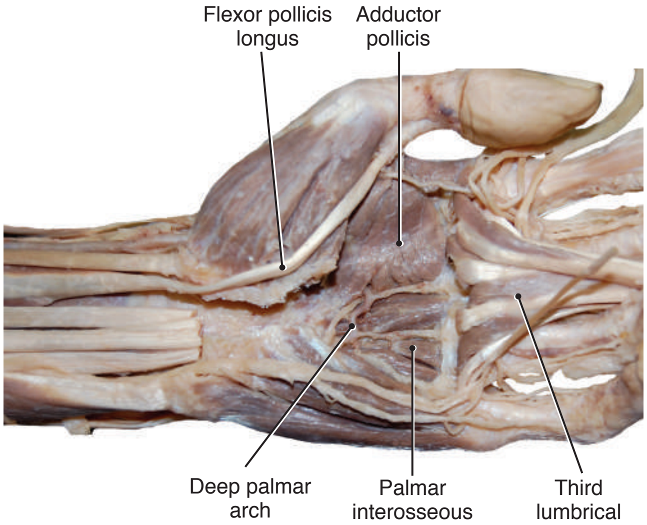

Flexor pollicis longus
Adductor pollicis
Deep palmar arch
Palmar interosseous
Third lumbrical

Fig. 9.53 Anterior forearm and hand with skin and aponeurosis removed; superficial and intermediate muscles reflected, revealing deep structures, including deep palmar arch and interosseous muscles.

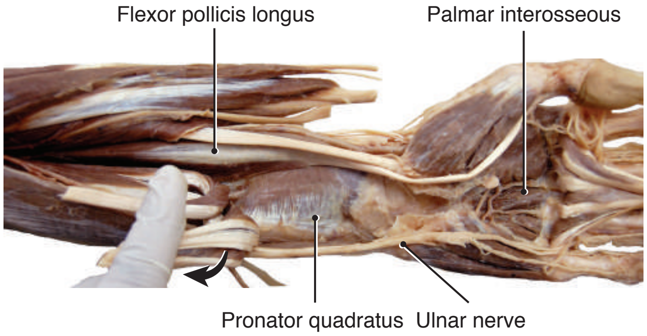

Flexor pollicis longus
Palmar interosseous
Pronator quadratus
Ulnar nerve

Fig. 9.54 Anterior hand and wrist with skin and aponeurosis removed and tendons cut, revealing deeper structures such as pronator quadratus muscle.

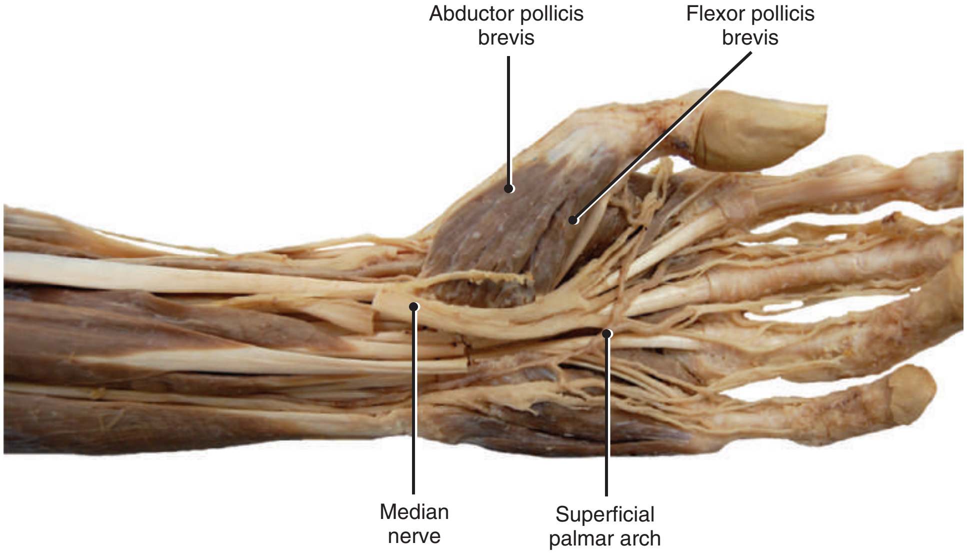

Abductor pollicis brevis
Flexor pollicis brevis
Median nerve
Superficial palmar arch

Fig. 9.55 Anterior view of hand and wrist with skin and aponeurosis removed. Median nerve is transected in distal anterior forearm. Note palmar cutaneous branch of median nerve crossing superficial to flexor retinaculum.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Median
  - ☐ Superficial branch
  - ☐ Recurrent branch
- ☐ Common palmar digital
  - ☐ Palmar digital
- ☐ Ulnar
  - ☐ Superficial branch
- ☐ Common palmar digital
  - ☐ Palmar digital
  - ☐ Dorsal branch
  - ☐ Dorsal digital
- ☐ Radial
  - ☐ Superficial branch
  - ☐ Dorsal digital branches

ARTERIES

- ☐ Ulnar
  - ☐ Superficial palmar arch
    - ☐ Common palmar digital
    - ☐ Palmar digital
- ☐ Radial
  - ☐ Deep arch
- ☐ Princeps pollicis
- ☐ Radialis indicis
- ☐ Palmar metacarpal
  - ☐ Palmar digital
  - ☐ Dorsal arterial arch
- ☐ Dorsal metacarpal
  - ☐ Dorsal digital

VEINS

- ☐ Dorsal digital
- ☐ Dorsal metacarpal
- ☐ Dorsal venous arch
  - ☐ Cephalic
  - ☐ Basilic
- ☐ Palmar digital

MUSCLES

Thenar Muscles

- ☐ Abductor pollicis brevis
- ☐ Flexor pollicis brevis
- ☐ Opponens pollicis brevis

Hypothenar Muscles

- ☐ Abductor digiti minimi brevis
- ☐ Flexor digiti minimi
- ☐ Opponens digiti minimi
- ☐ Palmaris brevis

Palmar Muscles

- ☐ Adductor pollicis
- ☐ Palmar interosseous
- ☐ Dorsal interosseous
- ☐ Lumbricals

LIGAMENTS

- ☐ Ulnar collateral
- ☐ Radial collateral
- ☐ Palmar carpal

CONNECTIVE TISSUE

- ☐ Digital fibrous sheath with anular and cruciate regions
- ☐ Palmar aponeurosis
- ☐ Flexor retinaculum
- ☐ Extensor retinaculum
- ☐ Vinculum longum

BONES

Carpal Bones

  - ☐ Scaphoid
  - ☐ Lunate
  - ☐ Triquetrum
  - ☐ Hamate
  - ☐ Capitate
  - ☐ Trapezium
  - ☐ Trapezoid
  - ☐ Pisiform
- ☐ Metacarpals
- ☐ Phalanges
  - ☐ Proximal
  - ☐ Middle
  - ☐ Distal

CLINICAL APPLICATIONS

SUBACROMIAL BURSITIS INJECTION

Gray's Anatomy for Students: 64, 392
Netter: 192, 193

Clinical Application

Provides relief for frequently inflamed bursa lying beneath the acromion near the supraspinatus tendon.

Anatomic Landmarks (Fig. IV.1)

- Anterior acromion
- Lateral acromion
- Posterior acromion
- Scapular spine
- Humeral head

ACROMIOCLAVICULAR JOINT INSPECTION

Gray's Anatomy for Students: 35, 388, 398
Netter: 192, 193

Clinical Application

Relieve pain from acromioclavicular joint irritation.

Anatomic Landmarks

- Anterior acromion
- Lateral acromion
- Acromioclavicular joint

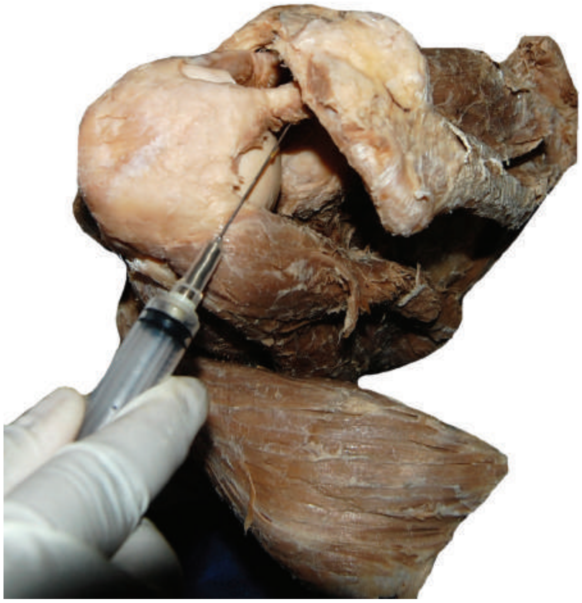


Fig. IV.1

GLENOHUMERAL JOINT INJECTION

Gray's Anatomy for Students: 390–392, 399
Netter: 192, 193

Clinical Application

Relieve pain from glenohumeral joint irritation.

Anatomic Landmarks (Figs. IV.2 and IV.3) (Posterior Approach)

- Skin
- Subcutaneous tissue
- Infraspinatus
- Joint capsule
- Glenoid cavity
- Humeral head
- Posterior cord of brachial plexus and its branches

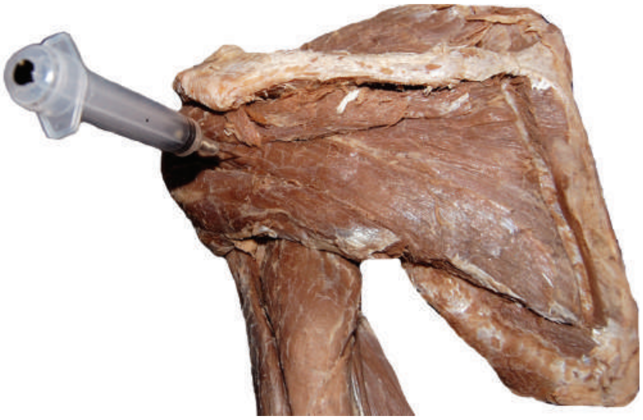


Fig. IV.2

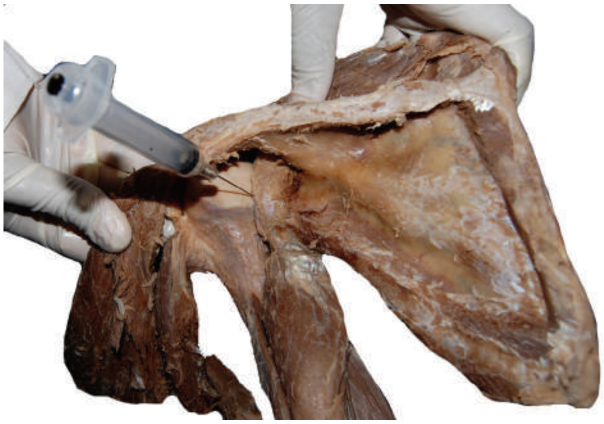


Fig. IV.3

STERNOCLAVICULAR JOINT INJECTION

Gray's Anatomy for Students: 62, 386, 388
Netter: 192, 193

Clinical Application

Relieve pain from sternoclavicular joint irritation.

Anatomic Landmarks

- **Skin**
- **Subcutaneous tissue**
- **Anterior sternoclavicular ligament**
- **Articular disc**
- **Medial clavicle**
- **Manubrium**
- **Brachiocephalic vein**
- **Subclavian artery**

BICIPITAL TENOSYNOVITIS INJECTION

Gray's Anatomy for Students: 396
Netter: 412, 421

Clinical Application

Acute trauma or chronic overuse of the biceps brachii tendon (usually long head); relieves pain and may prevent further shoulder pathology.

Anatomic Landmarks (Fig. IV.4)

- **Supinated upper limb**
- **Inferior border of pectoralis major**
- **Biceps brachii long head**
- **Humerus**

ULNAR NERVE BLOCK FOR CUBITAL TUNNEL SYNDROME

Gray's Anatomy for Students: 414, 424
Netter: 437

Clinical Application

For relief of pain caused by irritation of the ulnar nerve.

Anatomic Landmarks

- **Externally rotated upper limb**
- **Medial epicondyle**
- **Ulnar sulcus**
- **Olecranon**
- **Flexor carpi ulnaris**
- **Tendinous arch connecting two heads of flexor carpi ulnaris**
  Needle is advanced parallel to the ulnar nerve.

MEDIAN NERVE BLOCK (INJECTION AT WRIST)

Gray's Anatomy for Students: 448, 449
Netter: 436, 437, 450

Clinical Application

Median nerve block anesthetizes the lateral palmar 3½ digits.

Anatomic Landmarks (Figs. IV.5 and IV.6)

- **Skin**
- **Proximal palmar skin crease**
- **Subcutaneous tissue**
- **Flexor retinaculum**
- **Palmaris longus muscle (absent in approximately 20%)**

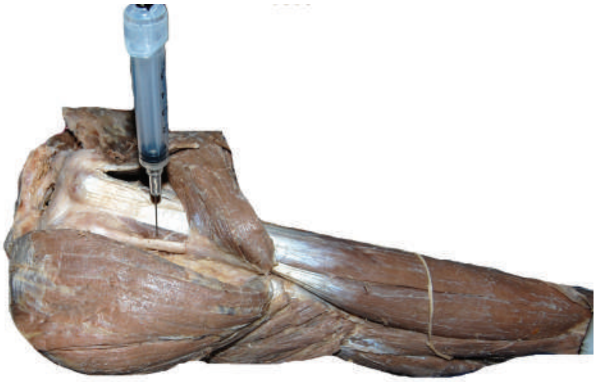


Fig. IV.4

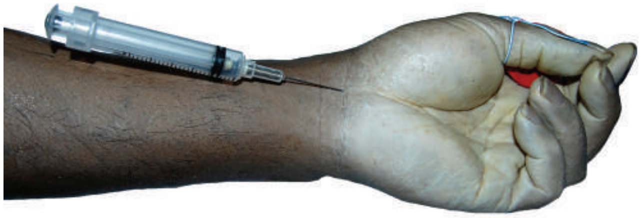


Fig. IV.5

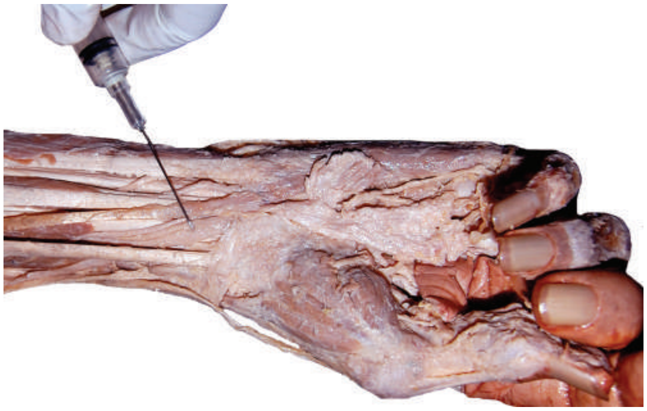


Fig. IV.6

- Flexor carpi radialis muscle
- Median nerve

DE QUERVAIN DISEASE INJECTION

Gray's Anatomy for Students: 452, 453
Netter: 457

Clinical Application

Relieve pain associated with stenosing tenosynovitis of the extensor pollicis brevis muscle.

Anatomic Landmarks (Figs. IV.7 and IV.8)

- Skin
- Subcutaneous tissue
- 1st dorsal compartment retinaculum
- Cephalic vein
- Radial artery branches
- 1st metacarpal base
- 1st metacarpophalangeal joint
- Extensor pollicis brevis

MEDIAL EPICONDYLITIS INJECTION

Gray's Anatomy for Students: 410
Netter: 438, 464

Clinical Application

Relief of pain caused by strain to the attachment of the forearm flexors at the medial epicondyle region.

Anatomic Landmarks

- Skin
- Subcutaneous tissue
- Common flexor tendon
- Medial epicondyle

LATERAL EPICONDYLITIS INJECTION

Gray's Anatomy for Students: 432–434
Netter: 438, 464

CLINICAL APPLICATION

Relief of pain caused by strain to the attachment of the forearm flexors at the lateral epicondyle region.

Anatomic Landmarks (Figs. IV.9 and IV.10)

- Skin
- Subcutaneous tissue
- Common extensor tendon
- Lateral epicondyle

DIGITAL NERVE BLOCK (HAND)

Gray's Anatomy for Students: 488
Netter: 456–458

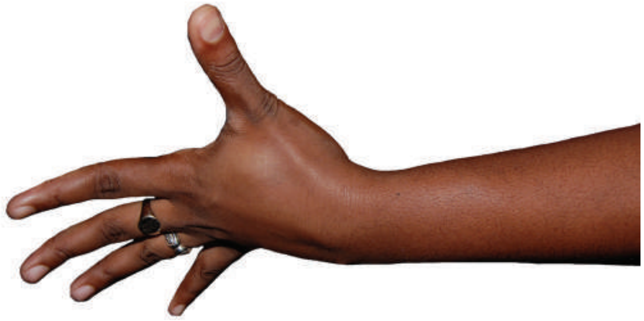


Fig. IV.7

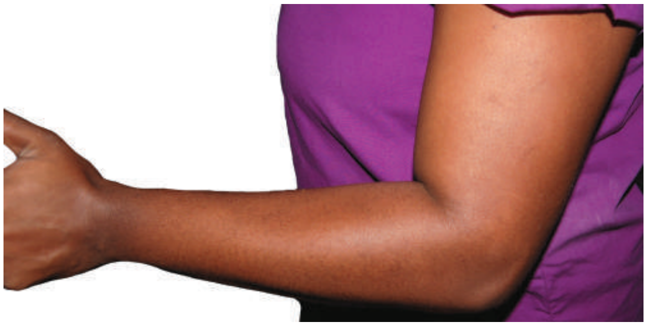


Fig. IV.9

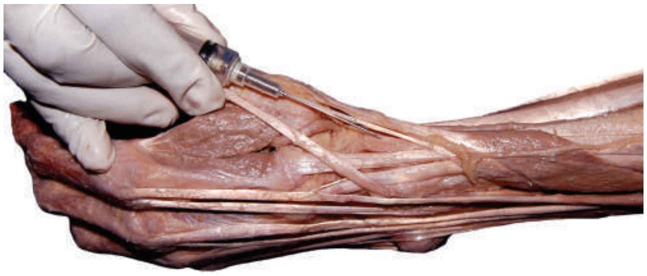


Fig. IV.8

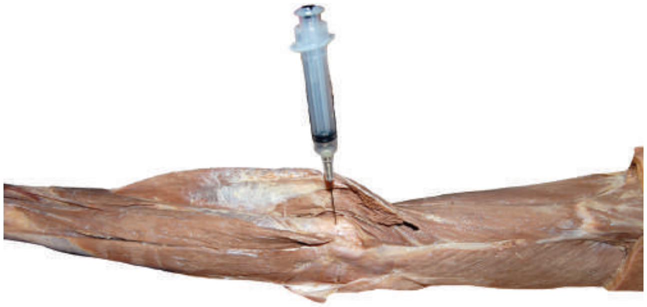


Fig. IV.10

Clinical Application

Anesthetize the palmar or dorsal side of a single or multiple digits to perform invasive procedures.

Anatomic Landmarks (Figs. IV.11 and IV.12)

- **Skin**
- **Subcutaneous tissue**
- **Common digital nerves/arteries**
- **Palmar digital nerves/arteries**
- **Dorsal digital nerves/arteries**
- **Metacarpophalangeal joints**
- **Proximal interphalangeal joints**

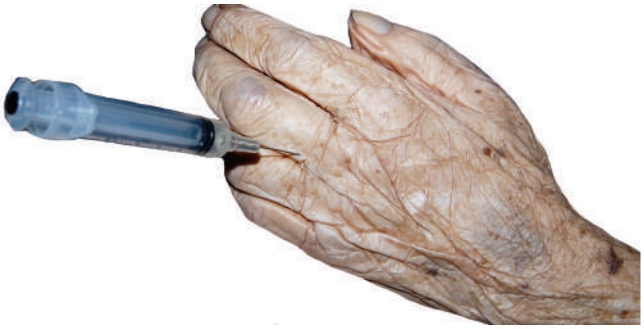


Fig. IV.11

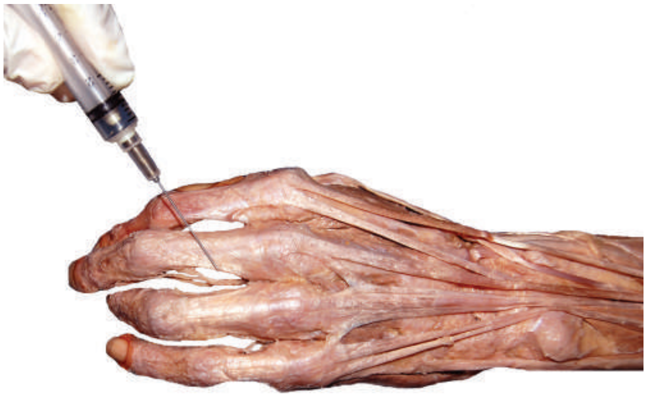


Fig. IV.12

VENIPUNCTURE OR PHLEBOTOMY

Gray's Anatomy for Students: 457
Netter: 406, 407

Clinical Application

To withdraw venous blood through needle penetration, or to insert intravenous (IV) cannula.

Anatomic Landmarks (Fig. IV.13)

- **Skin**
- **Subcutaneous tissue**
  Elbow: **Antecubital vein**
  Forearm: **Cephalic vein**
  Basilic vein
  Hand dorsum: **Cephalic vein**
  Basilic vein
  Dorsal venous arch
  Metacarpal veins

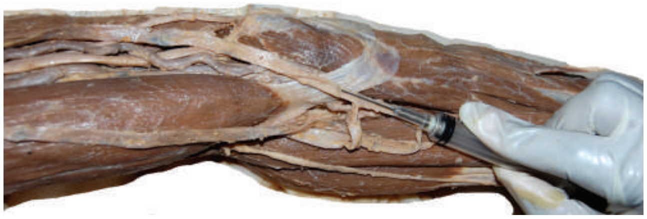


Fig. IV.13

CHAPTER 10 ANTERIOR ABDOMINAL WALL AND INGUINAL REGION

ATLAS REFERENCES

Netter: 249–264, 389, 390
McMinn: 217–225, 253
Gray's Atlas: 134–146, 148–150

BEFORE YOU BEGIN

In general, the abdomen can be divided into right and left superior (upper) quadrants and right and left inferior (lower) quadrants. This division in based on drawing vertical and horizontal lines through the umbilicus (Fig. 10.1).

More specifically, the anterior abdominal wall can be divided into regions: the right and left *hypochondriac* regions; the right and left *lateral* regions; the right and left *inguinal* regions; and the epigastric, umbilical, and pubic regions (Fig. 10.2).

Identify and palpate the following:

- Xiphoid process
- The lower costal margins, which form the subcostal plane
- The umbilicus (typically located at the level of 4th lumbar vertebra)
- Anterior superior iliac spines
- Pubic symphysis
- Pubic crests
- Iliac crests
- Tubercles of the iliac crests, which form the intertubercular plane when connected. This plane is located at the L5 level just inferior to the bifurcation of the abdominal aorta

SKIN AND SUPERFICIAL FASCIA

From the xiphoid process make a midline vertical skin incision from the xiphoid process to the pubic symphysis. Do not cut through the umbilicus; make a circumferential incision around it. From the costal margins make a second incision following this margin, from the midaxillary line to the xiphoid process. Finally, make an incision from the anterior superior iliac spine to the pubic symphysis (Fig. 10.3).

DISSECTION TIP

An alternate method is to make a vertical incision from the midaxillary line to 2 inches (5 cm) inferior to the anterior superior iliac spine. Make a transverse incision inferior to the inguinal ligament. Reflect the skin inferiorly to the level of the anterior superior iliac spine to expose the inguinal region.

- ○ **Dissect the skin from the midline and reflect it laterally (Fig. 10.4).**
- ○ **Expose the superficial fascia (fatty layer) beneath the skin (Fig. 10.5).**

ANATOMY NOTE

The fatty layer (fatty) of the superficial fascia is also known as *Camper's fascia,* whereas the membranous layer is known as *Scarpa's fascia.*

- ○ **As the superficial fascia is reflected (Fig. 10.6), note a superficial fatty layer and a deeper membranous layer.**
- ○ **Reflect the superficial fatty layer similar to the previously made skin incision.**
- ○ **Make a shallow incision with the scalpel and place your index finger into the incision so that lateral traction can be applied and reflection performed.**
- ○ **Continue with blunt dissection to identify the deep membranous fascia over the abdominal muscles.**
- ○ **Once this is achieved, continue the dissection using a scalpel.**

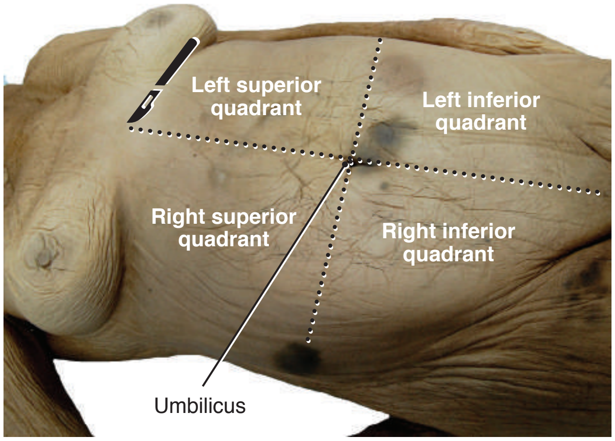

Left superior quadrant
Left inferior quadrant
Right superior quadrant
Right inferior quadrant
Umbilicus

Fig. 10.1 Anterior view of abdomen showing simplified division into quadrants.

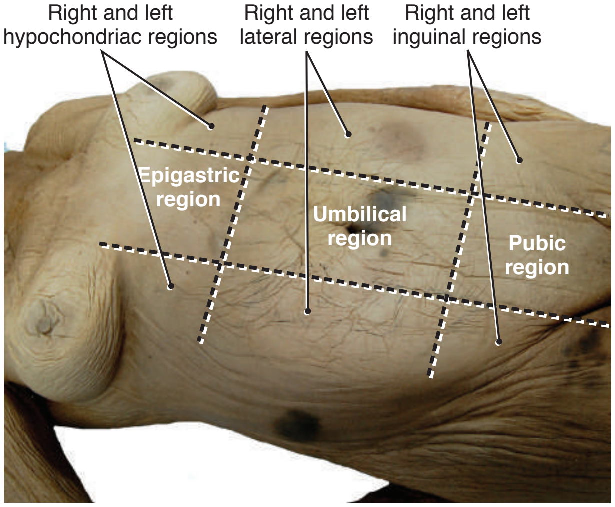

Right and left hypochondriac regions
Right and left lateral regions
Right and left inguinal regions
Epigastric region
Umbilical region
Pubic region

Fig. 10.2 Anterior view of abdomen showing division into regions.

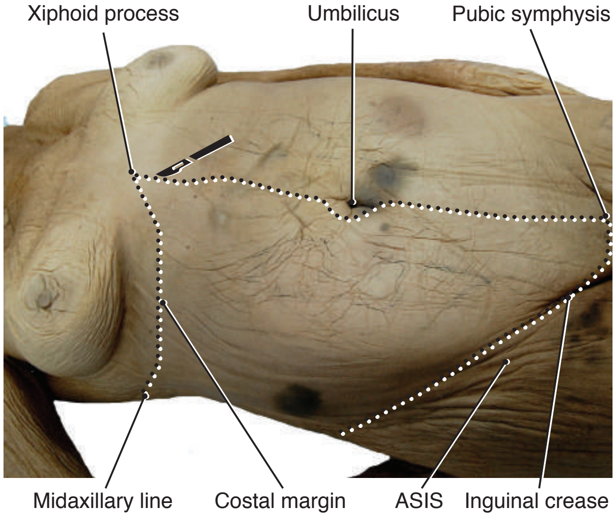

Xiphoid process
Umbilicus
Pubic symphysis
Midaxillary line
Costal margin
ASIS
Inguinal crease

Fig. 10.3 Anterior view of abdomen showing the skin incisions *(dashed lines)* used to begin dissection. *ASIS,* anterior superior iliac spine.

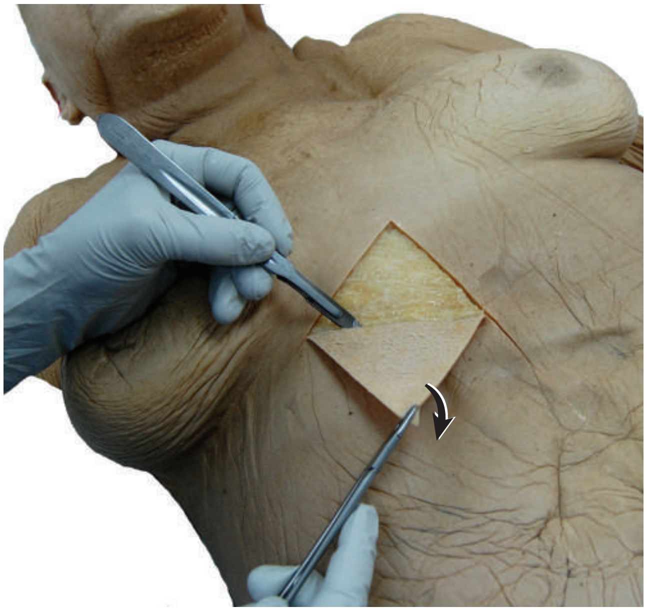


Fig. 10.4 Method used to reflect skin from underlying fascia. Note tension placed on corner of skin flap as scalpel liberates this layer from underlying fascia.

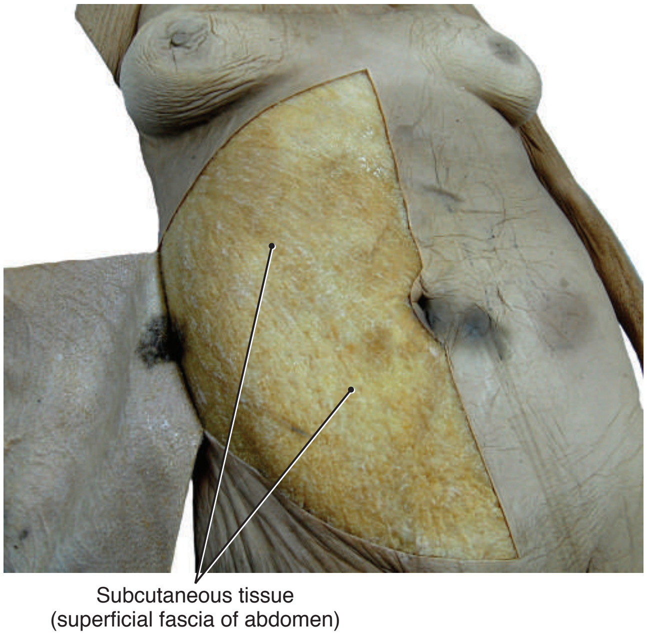

Subcutaneous tissue (superficial fascia of abdomen)

Fig. 10.5 Anterior view of abdomen showing skin reflection with underlying subcutaneous tissues.

MUSCLES OF THE ANTERIOR ABDOMINAL WALL

ANATOMY **NOTE**

The three flat muscles of the anterolateral abdominal wall—external abdominal oblique, internal abdominal oblique, and transversus abdominis—are covered by a superficial fascia and a deep fascia. The outermost fascia covering the external abdominal oblique muscle (deep) is called the *fascia of Gallaudet*.

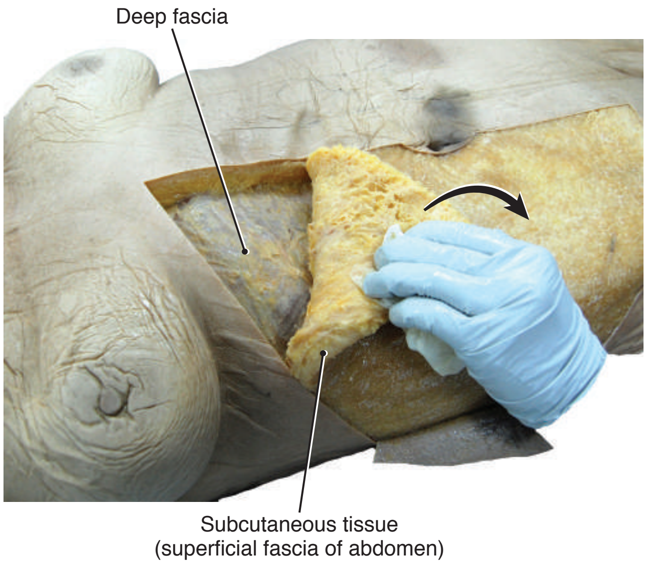


Fig. 10.6 Anterior view of abdomen with skin and fascia reflected from the midline on right side.

- Continue the dissection by reflecting the superficial fatty layer and exposing the muscles of the anterior abdomen (covered with deep fascia) and the outer layer of the rectus sheath (anterior lamina) (Fig. 10.7).
- At the level of the midaxillary line, remove the deep fascia and expose the external abdominal oblique muscle (Fig. 10.8).
- Clean the deep fascia over the external abdominal oblique and outer layer of the rectus sheath, and identify the linea alba, and linea semilunaris (at the lateral border of the rectus sheath) and inguinal ligament (Figs. 10.9 and 10.10).
- Once the external abdominal oblique muscle is exposed at the midabdomen on both sides, continue the reflection of the deep fascia over the pubic symphysis and inguinal ligament to further expose the external abdominal oblique muscle (Fig. 10.11).
- With forceps, lift the outer layer of the rectus sheath (anterior lamina) at the level of the xiphoid process.
- With scissors, make a small incision into the rectus sheath (anterior lamina) (Fig. 10.12).
- Lift the rectus sheath upward and identify the rectus abdominis muscle underneath it (Fig. 10.13).
- With your scalpel, detach the outer layer of the rectus sheath (anterior lamina) alongside its border with the external abdominal oblique muscle (Fig. 10.14).

DISSECTION TIP

An alternative method is to make a vertical incision at the midline and reflect the outer layer of the rectus sheath laterally from the linea alba.

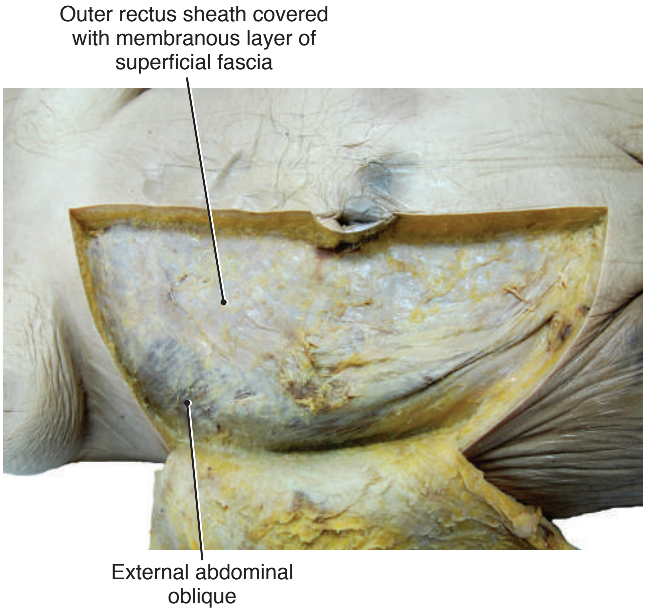
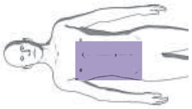


Fig. 10.7 With additional dissection, the external abdominal oblique muscle is identified with its contribution to the outer rectus sheath.



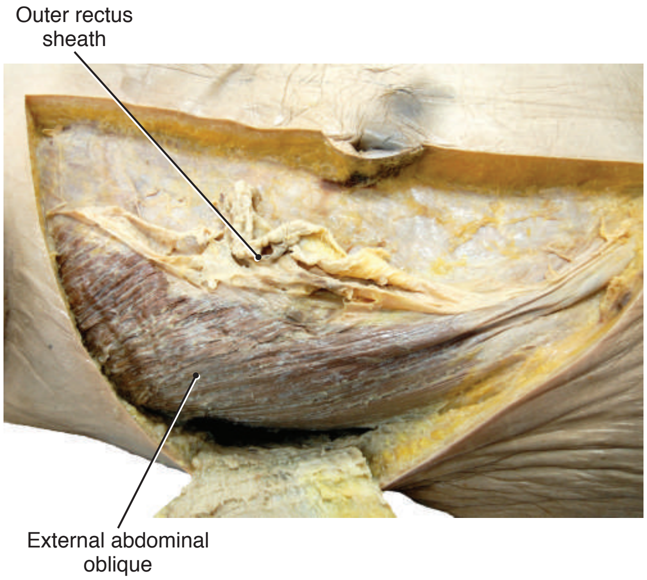
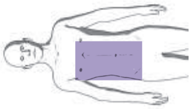


Fig. 10.8 Anterior view of abdomen noting exposed external abdominal oblique muscle and contributions medially into outer rectus sheath.



DISSECTION TIP

The tendinous intersections attach firmly to the anterior lamina of the rectus sheath. Employ sharp dissection when necessary to remove the anterior lamina. Observe the linea alba becoming wider and thicker above the umbilicus.

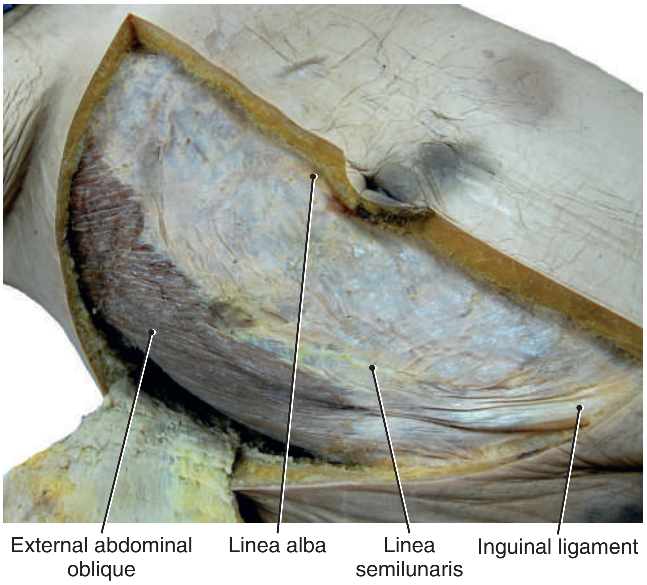
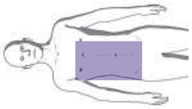

External abdominal oblique
Linea alba
Linea semilunaris
Inguinal ligament

Fig. 10.9 Anterior view of abdomen noting exposed external abdominal oblique muscle and contributions medially into outer rectus sheath.



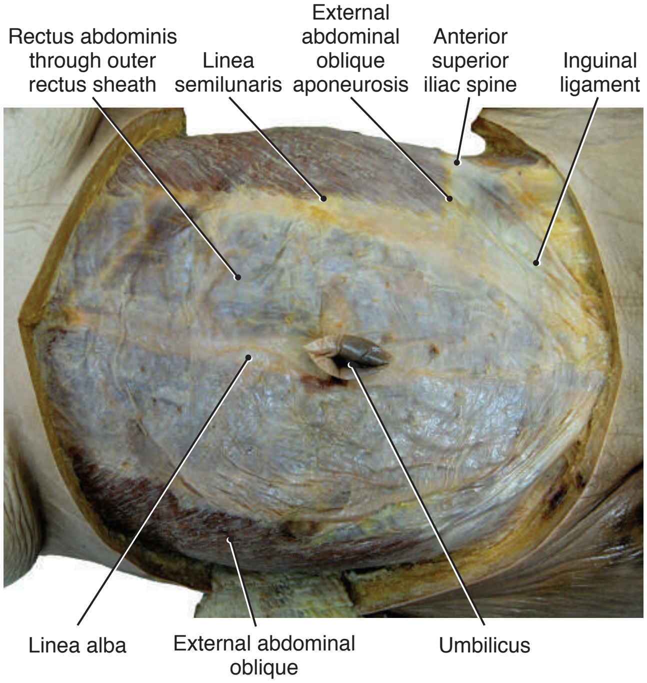
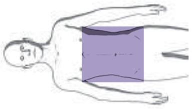

Rectus abdominis through outer rectus sheath
Linea semilunaris
External abdominal oblique aponeurosis
Anterior superior iliac spine
Inguinal ligament
Linea alba
External abdominal oblique
Umbilicus

Fig. 10.10 Anterior view of full abdominal exposure showing anatomic landmarks. Note linea alba traveling in the midline with interposed umbilicus.



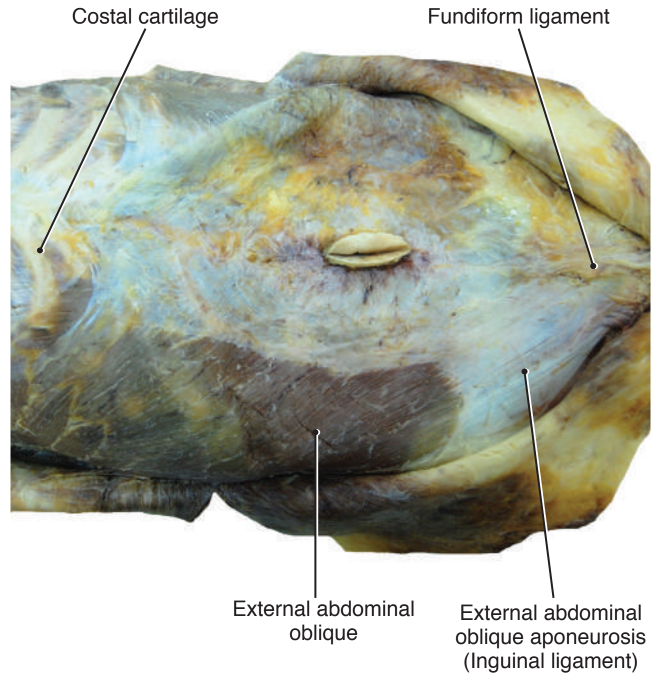
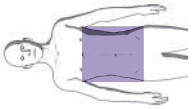

Costal cartilage
Fundiform ligament
External abdominal oblique
External abdominal oblique aponeurosis (Inguinal ligament)

Fig. 10.11 Anterior view of abdomen noting upper attachments of external abdominal oblique muscle along costal margin and inferiorly with specialization of its aponeurosis, the inguinal ligament.



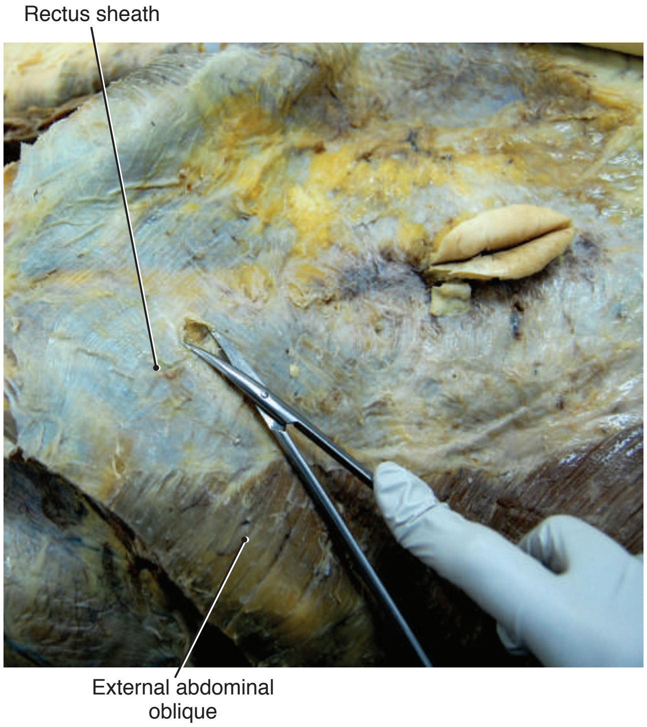
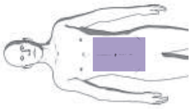

Rectus sheath
External abdominal oblique

Fig. 10.12 Anterior view of abdomen showing expansion of outer rectus fascia.



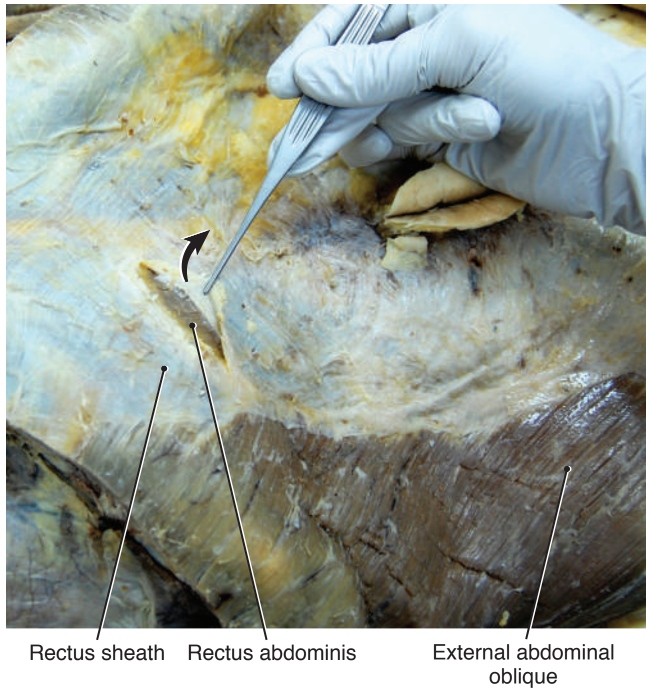
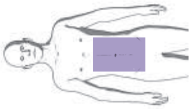

Rectus sheath
Rectus abdominis
External abdominal oblique

Fig. 10.13 Anterior view of abdomen noting continued opening of outer rectus sheath.



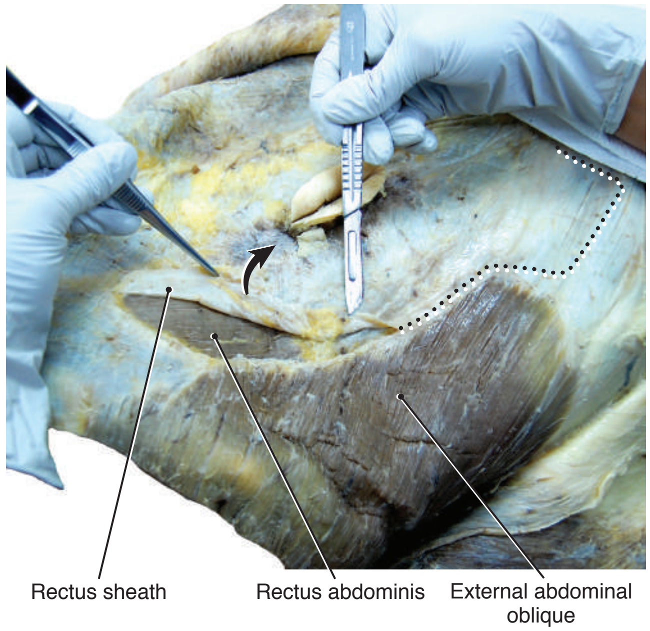
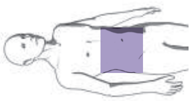

Rectus sheath
Rectus abdominis
External abdominal oblique

Fig. 10.14 Outer sheath is exposed along lateral edge of the junction of external abdominal oblique muscle with its aponeurosis.



- **Reflect the outer layer of the rectus sheath (anterior lamina) from the xiphoid process to pubic symphysis and completely expose the rectus abdominis muscle. Leave a small part of the rectus sheath intact (Fig. 10.15).**

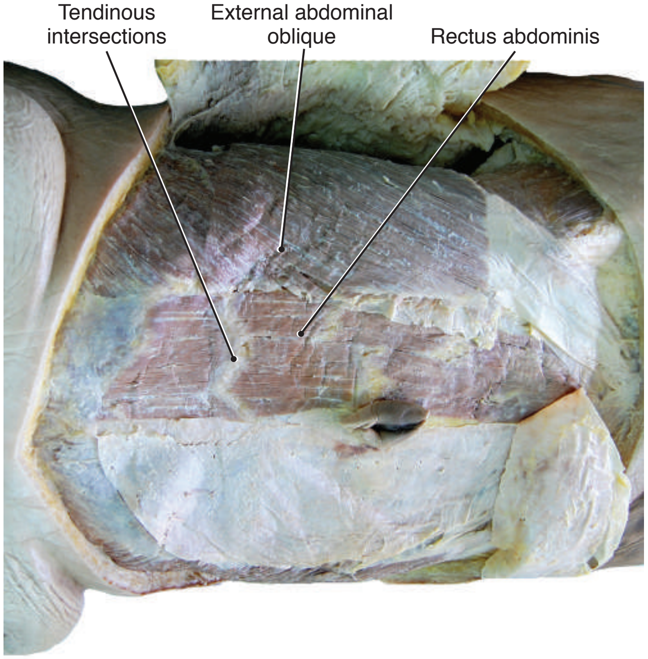
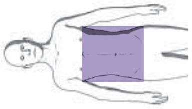

Tendinous intersections
External abdominal oblique
Rectus abdominis

Fig. 10.15 Rectus abdominis muscle is exposed more or less along its entirety.



- **Identify the tendinous intersections, formed by the tendinous inscriptions of the rectus abdominis muscle and its segmentation, and the *linea alba,* the avascular fusion point of the aponeuroses of the muscles of the anterior abdominal wall at the midline extending from the xiphoid process to the pubic symphysis. (Fig. 10.16).**
- **At the inferior portion of the rectus abdominis muscle and anterior to it, identify the pyramidalis muscle (see Fig. 10.16).**

DISSECTION TIP

The pyramidalis muscle is absent in about 20% of cases.

DISSECTION TIP

During the dissection of the anterior abdominal wall, note the anterior primary rami of the 7th to 12th thoracic nerves (T7 to T12) supplying the muscles of the anterior abdominal wall. Below are five important nerves in this region and some anatomic landmarks:

1. T7, usually found just inferior to xiphoid process.
2. T10, at the level of the umbilicus.
3. T12, at the level just above the pubis.
4. Ilioinguinal nerve, at the level of the anterior superior iliac spine, underneath the external abdominal oblique muscle.

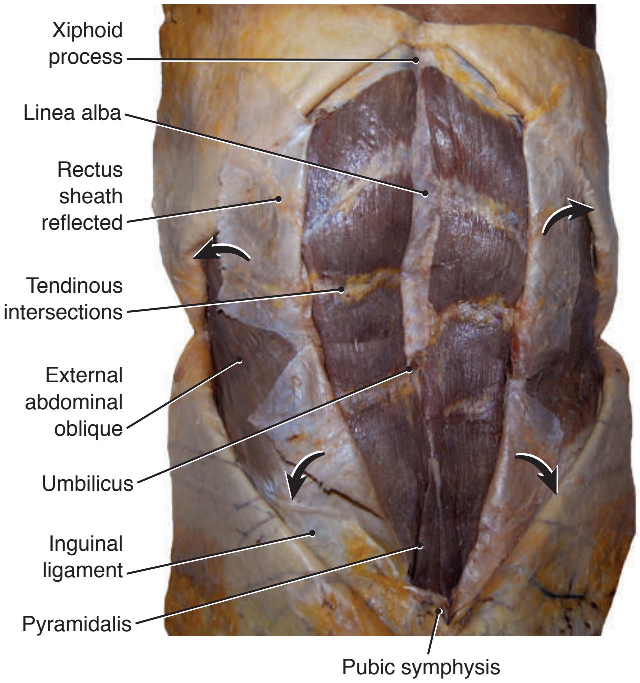
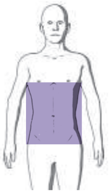

Xiphoid process
Linea alba
Rectus sheath reflected
Tendinous intersections
External abdominal oblique
Umbilicus
Inguinal ligament
Pyramidalis
Pubic symphysis

Fig. 10.16 Continued exposure of outer rectus sheath.



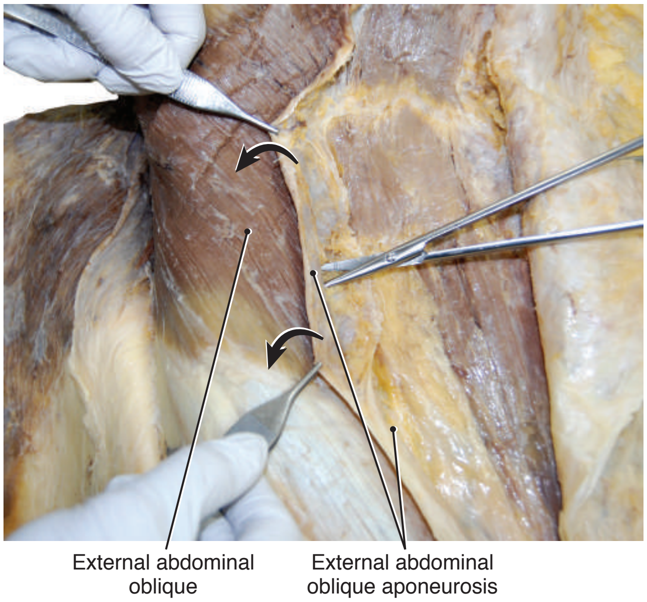
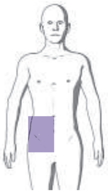

External abdominal oblique
External abdominal oblique aponeurosis

Fig. 10.17 Continued exposure of outer rectus sheath.



5. Iliohypogastric nerve, 3 to 4 cm above the ilioinguinal nerve at the level of the anterior superior iliac spine.

- **At the level of the linea semilunaris, make a small incision between the external abdominal oblique and rectus abdominis muscles (Fig. 10.17).**
- **Retract the external abdominal oblique muscle laterally, and expose the fibers of the underlying internal abdominal oblique muscle (Fig. 10.18).**
- **Similarly, cut the internal abdominal oblique muscle at the level of the linea semilunaris, and expose the underlying transversus abdominis muscle (Fig. 10.19).**
- **Note the difference in the muscle fiber orientation among the external abdominal oblique, internal abdominal oblique, and transversus abdominis muscles.**
- **Cut the transversus abdominis muscle and reflect it to expose the underlying transversalis fascia (Fig. 10.20).**
- **Between the internal oblique and transversus abdominis muscles, identify anterior primary rami from T7 to T12 (see Fig. 10.20).**
- **Note the fascia that lies deep to the transversus abdominis (at its deepest surface) is the *transversalis fascia* (see Fig. 10.20).**

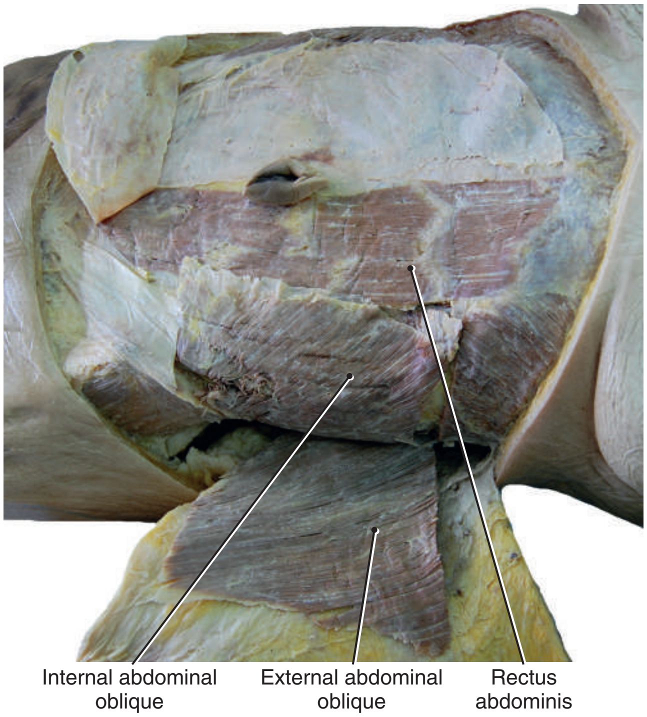
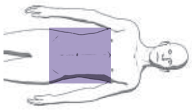

Internal abdominal oblique
External abdominal oblique
Rectus abdominis

Fig. 10.18 After reflecting part of the external abdominal oblique muscle, the deeper layer composed of the internal abdominal oblique muscle is visualized.



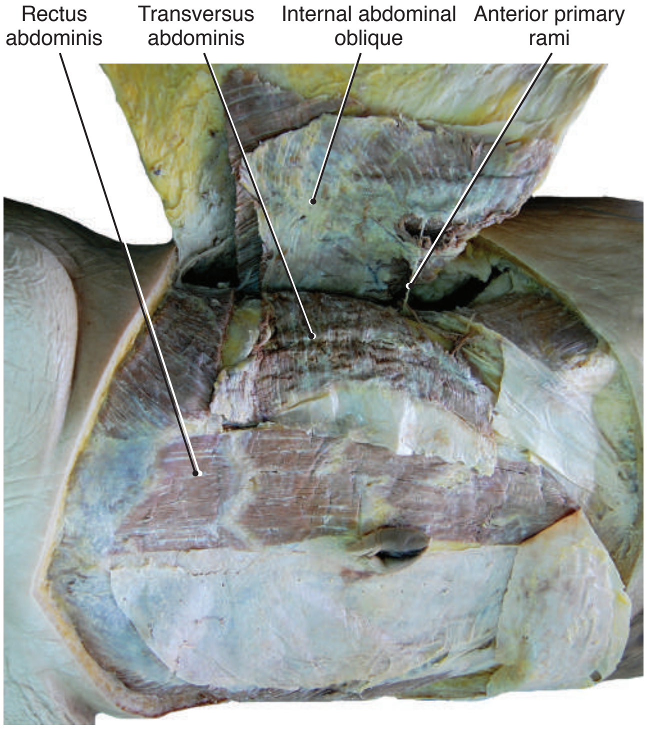
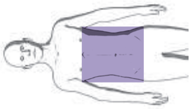

Rectus abdominis
Transversus abdominis
Internal abdominal oblique
Anterior primary rami

Fig. 10.19 After part of the internal abdominal oblique is reflected, the deeper transversus abdominis muscle is visible.



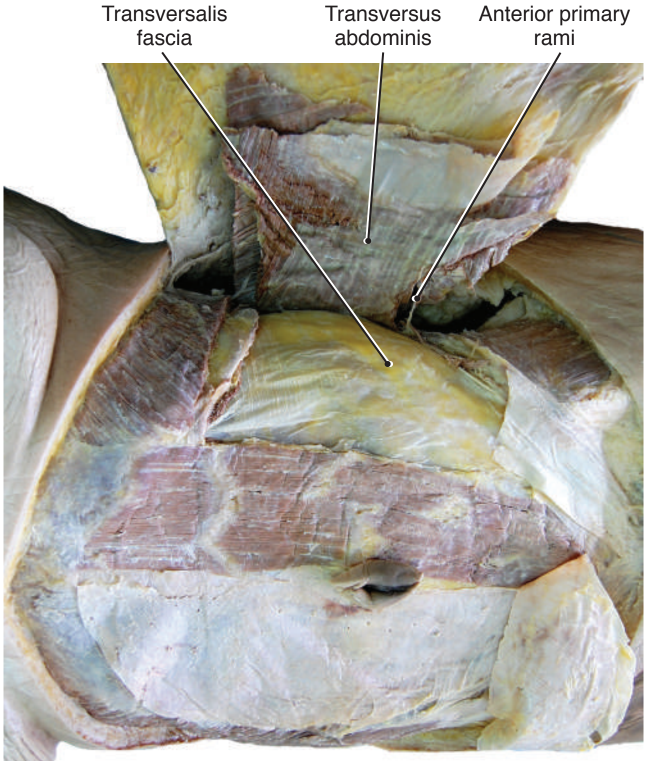
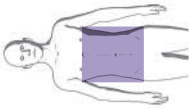

Transversalis fascia
Transversus abdominis
Anterior primary rami

Fig. 10.20 After reflecting part of the transversus abdominis muscle, the deeper transversalis fascia is observed.



DISSECTION TIP

An alternate method is to make a vertical incision at the external abdominal oblique muscle on the midaxillary line, where the underlying internal abdominal oblique and transversus abdominis muscles are usually the thickest. Reflect the external abdominal oblique muscle, and identify the internal abdominal oblique muscle. Continue the same process with the internal abdominal oblique, and identify the transversus abdominis muscle (Figs. 10.21 and 10.22).

- At the level of the xiphoid process, make a shallow transverse incision at the rectus abdominis muscle (Fig. 10.23).
- Lift the rectus abdominis from its posterior lamina of the rectus sheath, and reflect it downward (see Fig. 10.23 and Plate 10.1).
- Identify the primary ventral rami of T7 to T12 penetrating the posterior lamina of the rectus sheath (Fig. 10.24).
- Reflect the rectus abdominis muscle superiorly from the posterior lamina of the rectus sheath, and identify, on its deep surface, the superior and inferior epigastric arteries (Fig. 10.25).

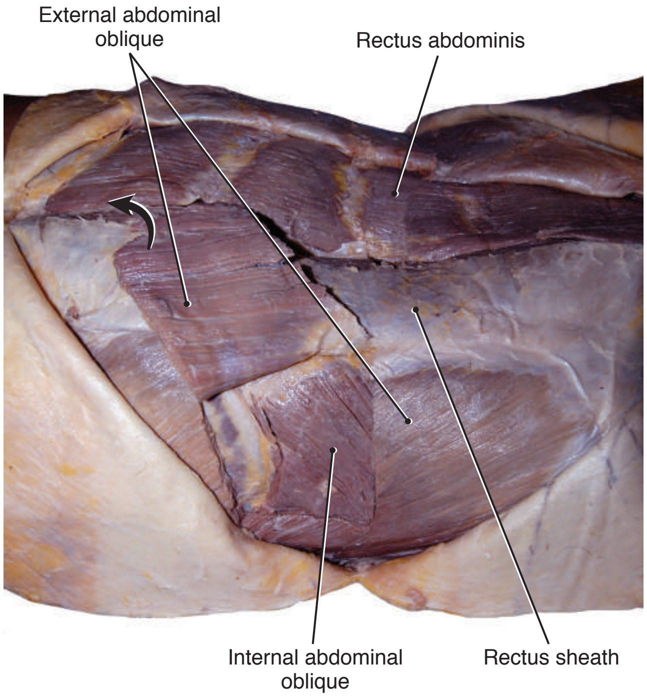
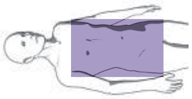
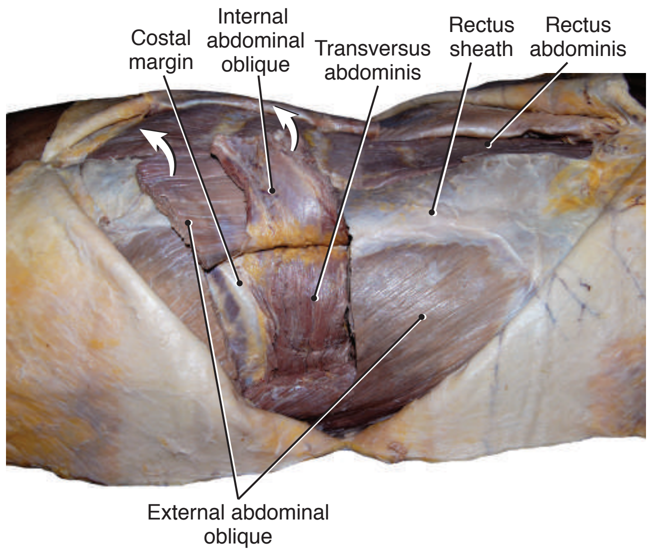

External abdominal oblique
Rectus abdominis
Internal abdominal oblique
Rectus sheath

Fig. 10.21 Anterior view showing external abdominal oblique and rectus abdominis muscles.




Costal margin
Internal abdominal oblique
Transversus abdominis
Rectus sheath
Rectus abdominis
External abdominal oblique

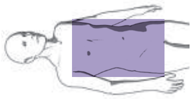
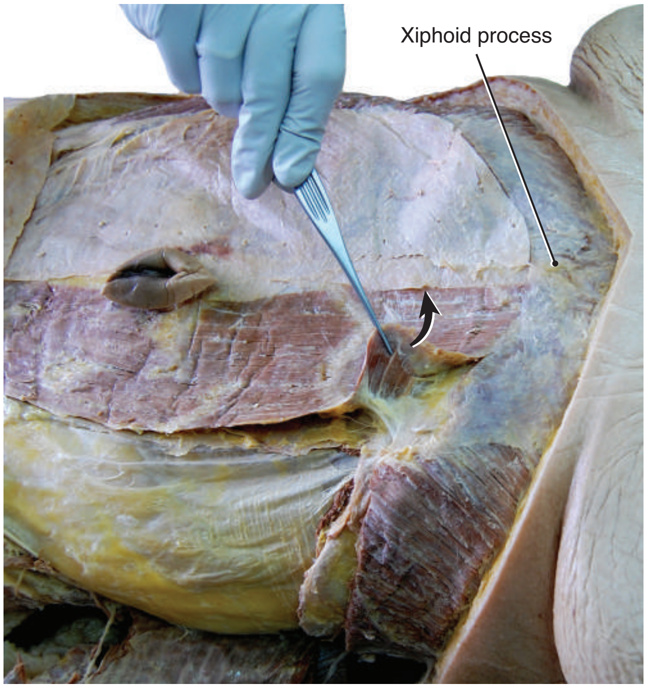


Fig. 10.22 Additional view after muscular flap cuts showing outermost external abdominal oblique muscle and reflected, deeper-lying internal abdominal oblique muscle. Deep to reflected internal abdominal oblique, the transversus abdominis muscle is seen.


Xiphoid process

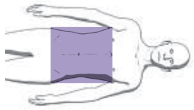


Fig. 10.23 The rectus abdominis muscle is reflected inferiorly.

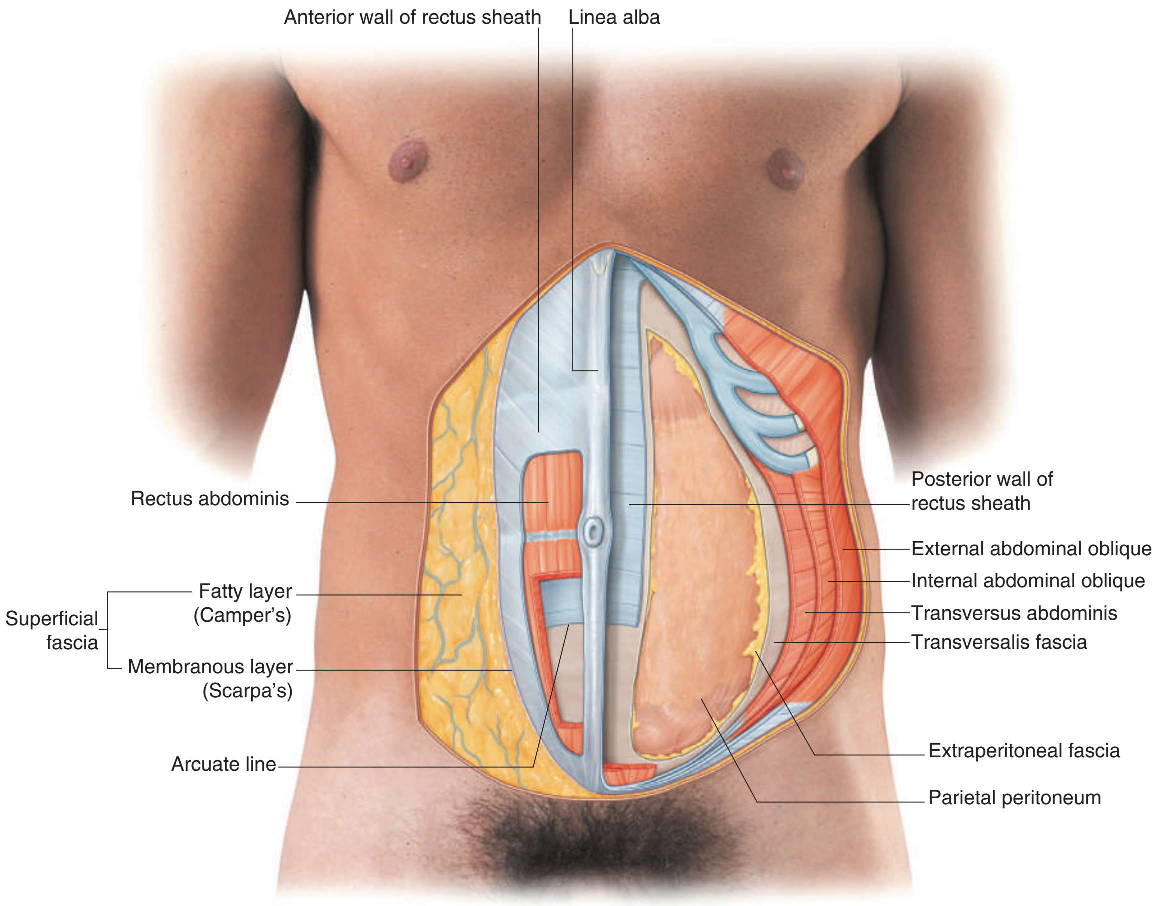

Anterior wall of rectus sheath
Linea alba
Rectus abdominis
Superficial fascia
Fatty layer (Camper's)
Membranous layer (Scarpa's)
Arcuate line
Posterior wall of rectus sheath
External abdominal oblique
Internal abdominal oblique
Transversus abdominis
Transversalis fascia
Extraperitoneal fascia
Parietal peritoneum

Plate 10.1 Layers of the anterior abdominal wall.

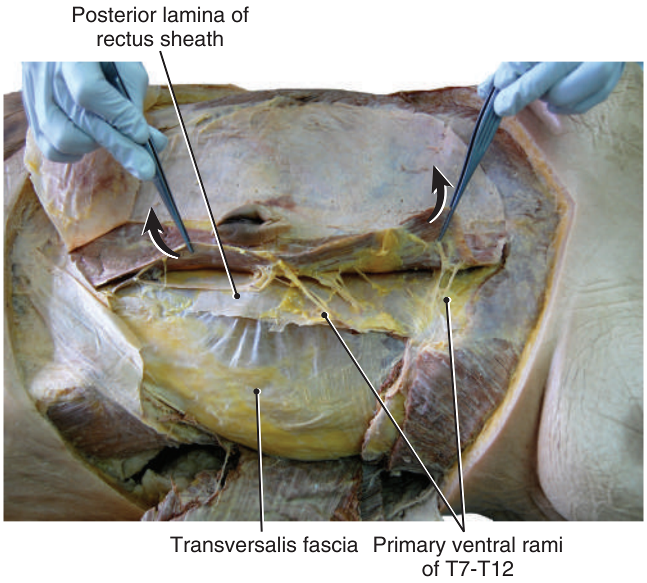
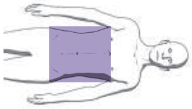

Posterior lamina of rectus sheath
Transversalis fascia
Primary ventral rami of T7-T12

Fig. 10.24 With reflection of the rectus abdominis muscle, the segmental nerves of this region are appreciated.



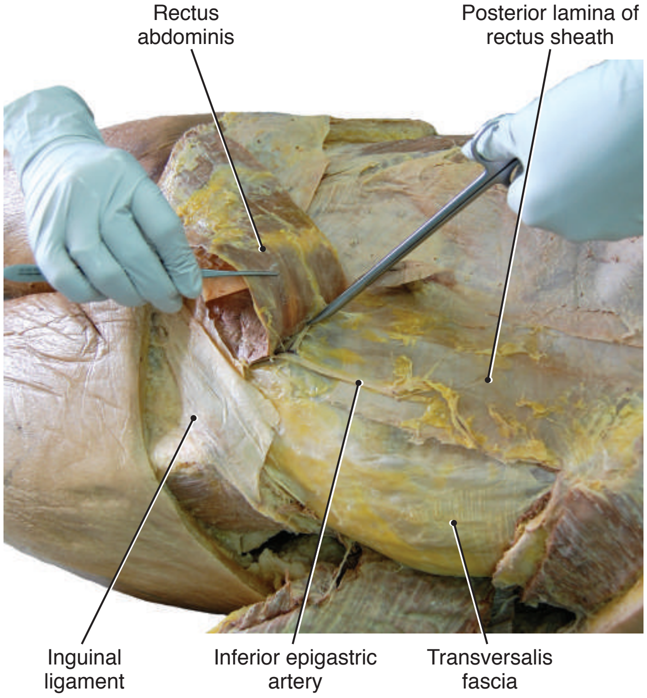
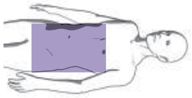

Rectus abdominis
Posterior lamina of rectus sheath
Inguinal ligament
Inferior epigastric artery
Transversalis fascia

Fig. 10.25 With continued reflection of the rectus abdominis muscle, the inferior epigastric vessels are seen.



DISSECTION TIP

The superior epigastric artery may be difficult to identify.

- **Just inferior to the umbilicus, identify the arcuate line of the rectus sheath, where the posterior lamina of the sheath is formed only by transversalis fascia (Figs. 10.26, 10.27, and 10.28).**

INGUINAL REGION

DISSECTION TIP

Complete this dissection preferably on one side only! It is important to leave one side intact so that you can compare.

- **Identify the inferior edge of the aponeurosis of the external abdominal oblique muscle, the *inguinal ligament* (Fig. 10.28, Plate 10.2).**
- **Reflect part of the skin over the superior portion of the thigh, and identify the great saphenous vein (Fig. 10.29).**
- **Extend the skin flap medially and expose the inferior border of the inguinal ligament (Fig. 10.30).**
- **Cut the skin covering the spermatic cord inferiorly toward the testis (Fig. 10.31).**
- **Clean the adipose tissue and identify the superficial (external) inguinal ring and the spermatic cord covered**

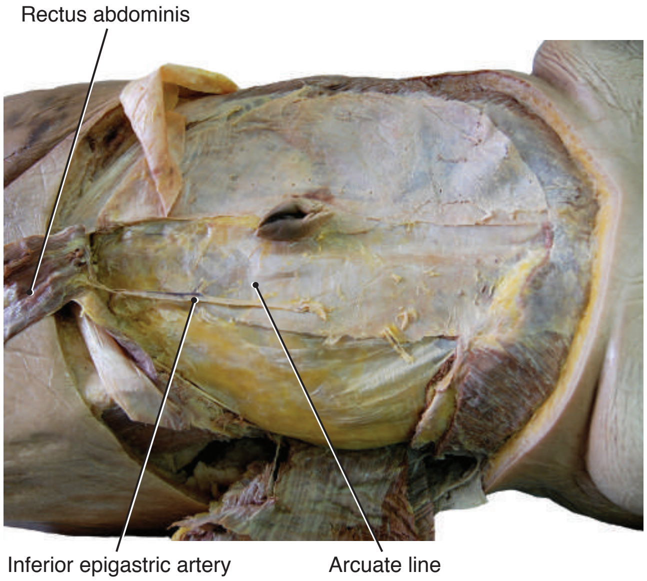
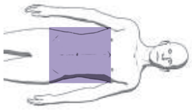

Rectus abdominis
Inferior epigastric artery
Arcuate line

Fig. 10.26 Rectus abdominis muscle is reflected superiorly, and inferior epigastric vessels are seen. Note the arcuate line.



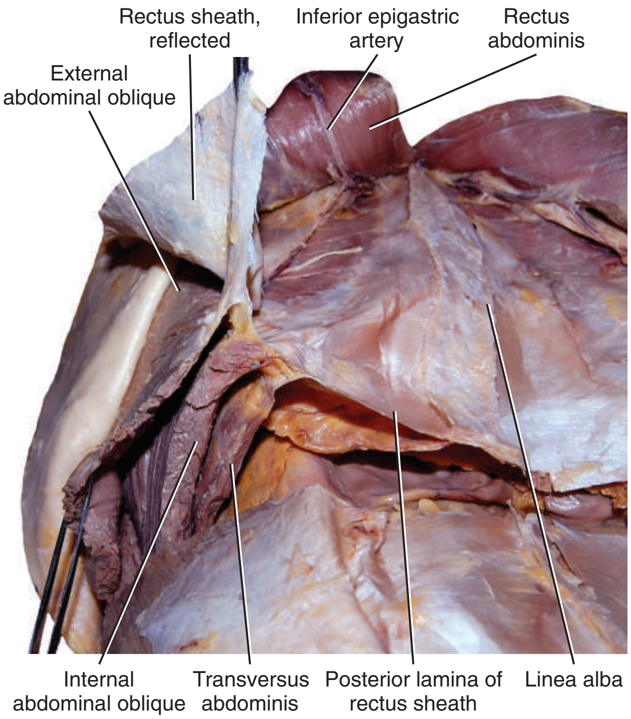

Rectus sheath, reflected
Inferior epigastric artery
Rectus abdominis
External abdominal oblique
Internal abdominal oblique
Transversus abdominis
Posterior lamina of rectus sheath
Linea alba

Fig. 10.27 Anterior view of the left abdominal wall muscles. Note that rectus abdominis muscles are reflected inferiorly and shown laterally are the external and internal oblique and transversus abdominis muscles.

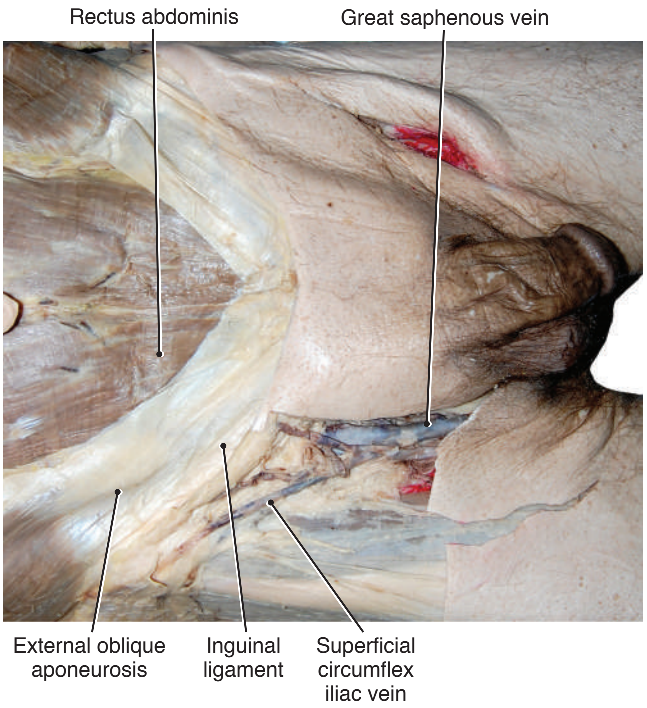

Rectus abdominis
Great saphenous vein
External oblique aponeurosis
Inguinal ligament
Superficial circumflex iliac vein

Fig. 10.29 Anterior view of the inguinal region in the male.

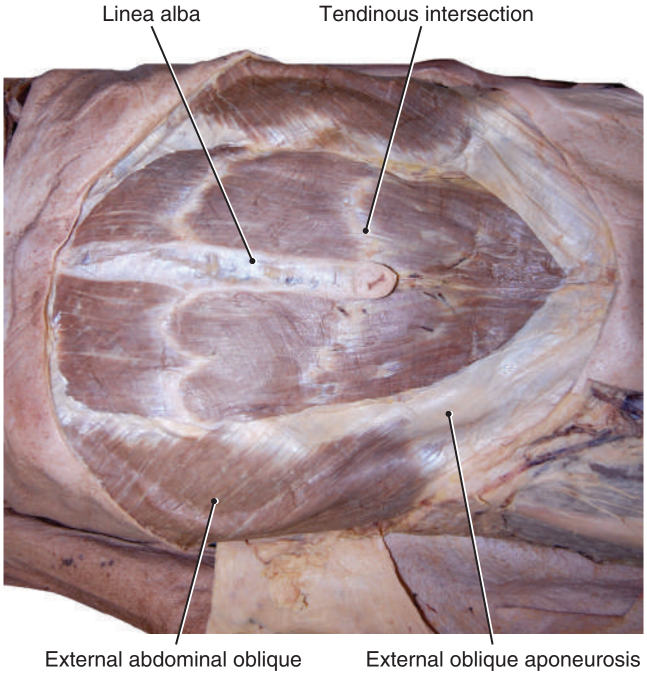
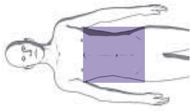

Linea alba
Tendinous intersection
External abdominal oblique
External oblique aponeurosis

Fig. 10.28 Anterior view of anterior abdominal wall. With muscles intact, note the linea alba and external abdominal oblique muscle and its aponeurosis.



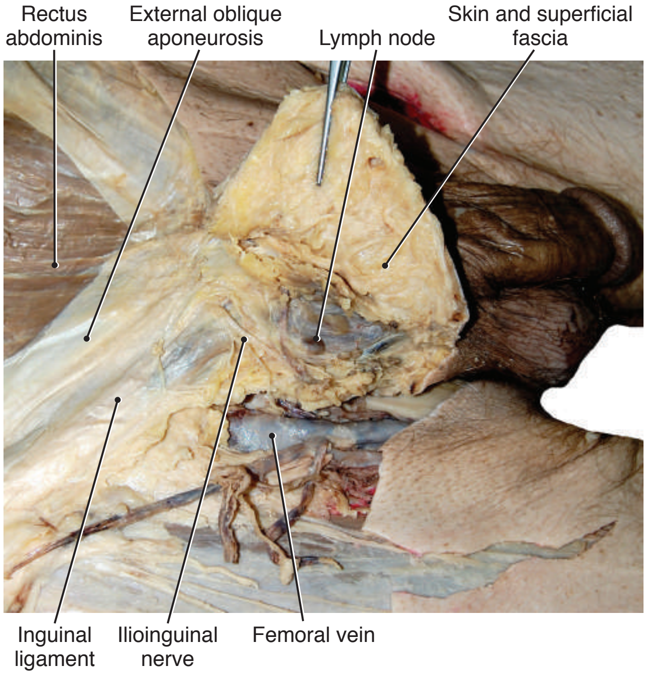

Rectus abdominis
External oblique aponeurosis
Lymph node
Skin and superficial fascia
Inguinal ligament
Ilioinguinal nerve
Femoral vein

Fig. 10.30 Anterior view of the inguinal region in the male showing the ilioinguinal nerve.

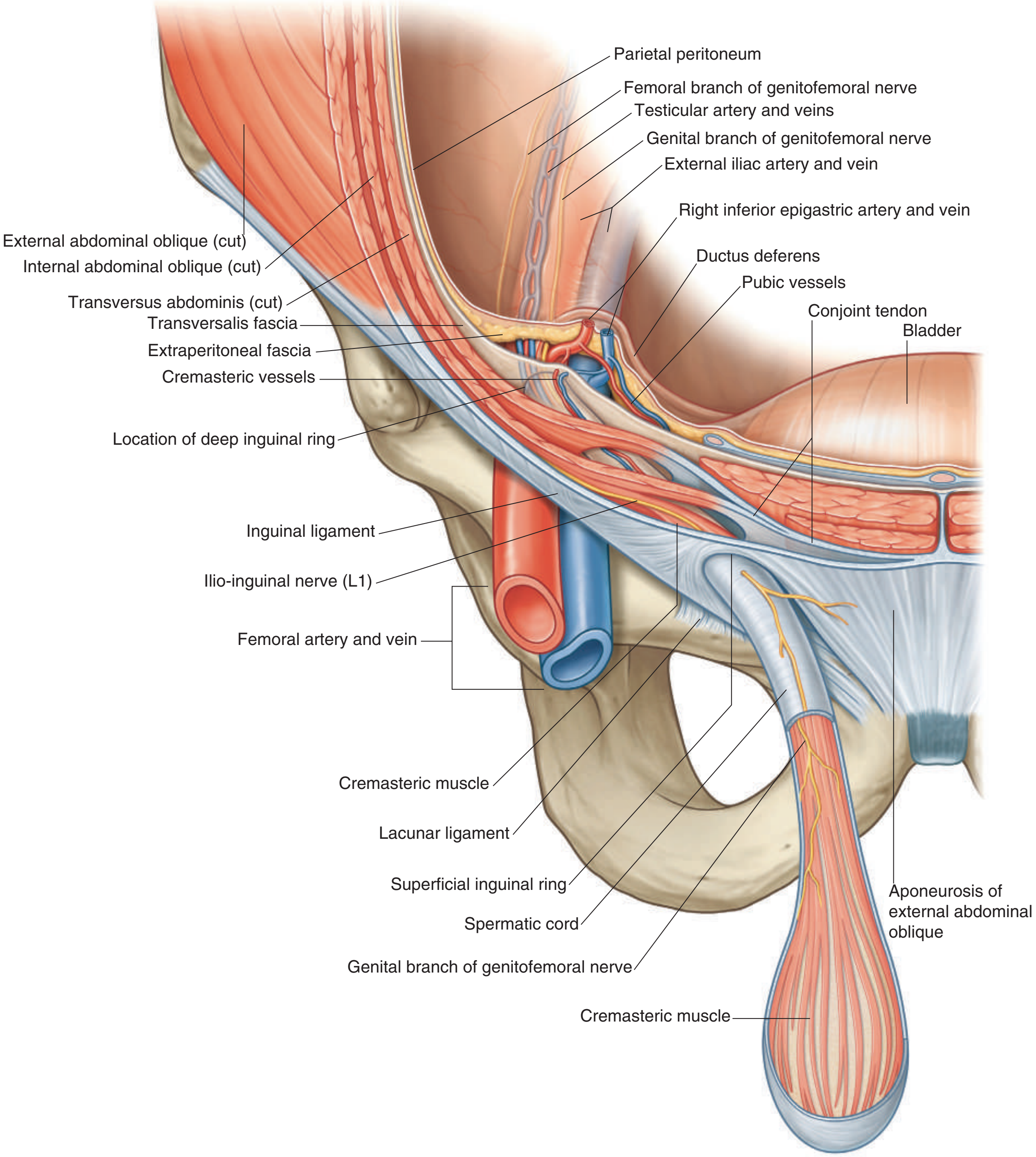

Parietal peritoneum
Femoral branch of genitofemoral nerve
Testicular artery and veins
Genital branch of genitofemoral nerve
External iliac artery and vein
Right inferior epigastric artery and vein
Ductus deferens
Pubic vessels
Conjoint tendon
Bladder
External abdominal oblique (cut)
Internal abdominal oblique (cut)
Transversus abdominis (cut)
Transversalis fascia
Extraperitoneal fascia
Cremasteric vessels
Location of deep inguinal ring
Inguinal ligament
Ilio-inguinal nerve (L1)
Femoral artery and vein
Cremasteric muscle
Lacunar ligament
Superficial inguinal ring
Spermatic cord
Genital branch of genitofemoral nerve
Aponeurosis of external abdominal oblique
Cremasteric muscle

Plate 10.2 Inguinal canal and spermatic cord.

by the external spermatic fascia (see Figs. 10.31 and 10.32).

- Identify the superomedial part of the inguinal ligament, the *superior crus*, and the inferolateral part, the *inferior crus* (Fig. 10.33).
- Just superior and anterior to the superior crus, identify the ilioinguinal nerve.
- Look for the genital branch of the genitofemoral nerve as it travels through the internal and the external inguinal rings within the spermatic cord.
- Retract the testis laterally (see Fig. 10.33).
- With scissors, cut the aponeurosis of the external oblique muscle between the two crura at the external inguinal ring (Fig. 10.34).
- Place the scissors underneath the external spermatic fascia, and make a small incision (Fig. 10.35) to expose the contents of the spermatic cord (Fig. 10.36).

DISSECTION **TIP**

Place your index finger in the opening of the superficial ring to appreciate the oblique course of the *spermatic cord* through the body wall toward the internal ring.

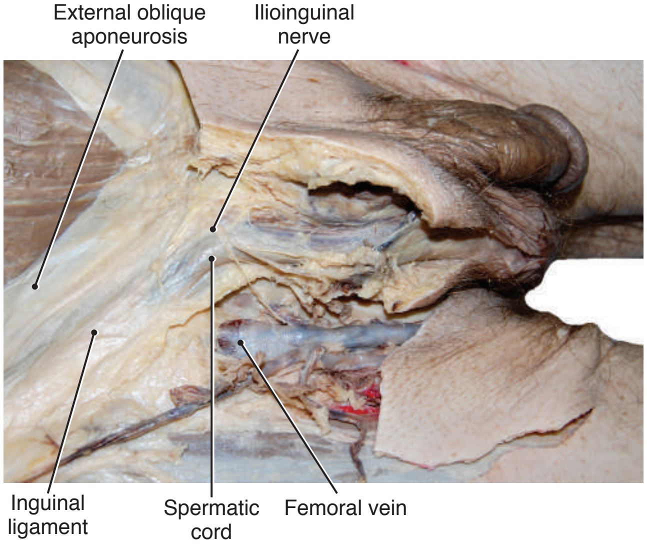

External oblique aponeurosis
Ilioinguinal nerve
Inguinal ligament
Spermatic cord
Femoral vein

Fig. 10.31 Anterior view of the inguinal region in the male.

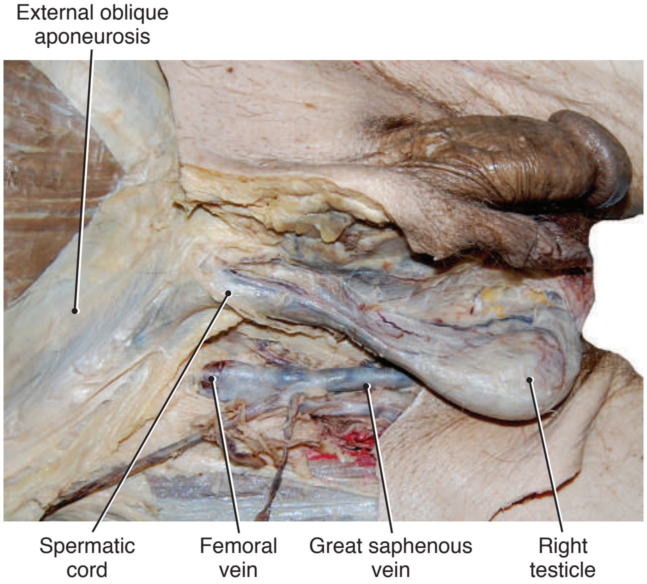

External oblique aponeurosis
Spermatic cord
Femoral vein
Great saphenous vein
Right testicle

Fig. 10.33 Inguinal region, noting superficial ring of inguinal canal and spermatic cord and right testicle.

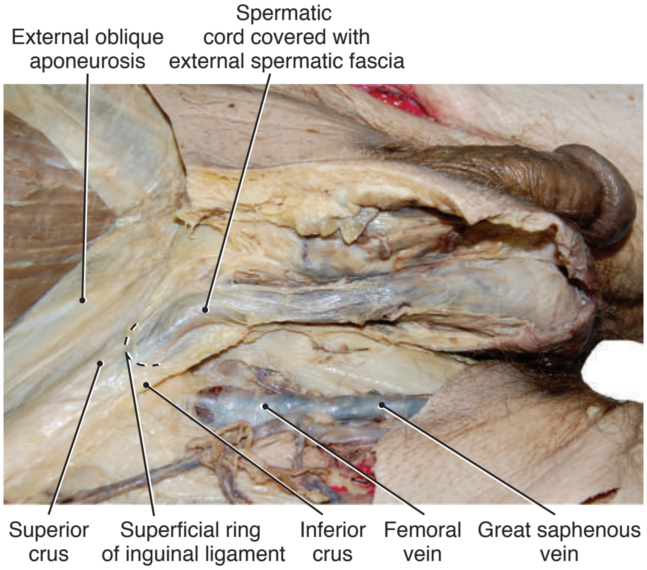

External oblique aponeurosis
Spermatic cord covered with external spermatic fascia
Superior crus
Superficial ring of inguinal ligament
Inferior crus
Femoral vein
Great saphenous vein

Fig. 10.32 The inguinal region noting the inguinal ligament.

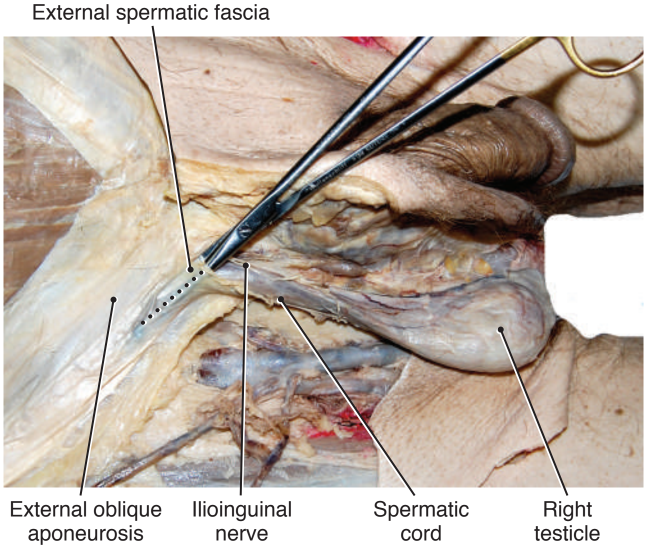

External spermatic fascia
External oblique aponeurosis
Ilioinguinal nerve
Spermatic cord
Right testicle

Fig. 10.34 Inguinal and proximal femoral regions.

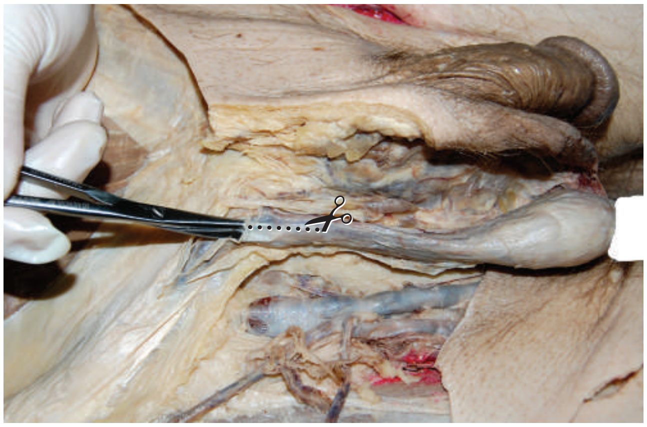


Fig. 10.35 Inguinal and proximal femoral regions.

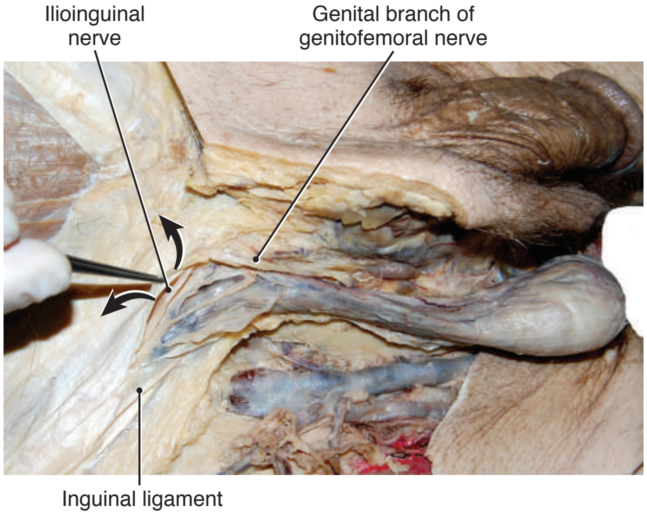

Ilioinguinal nerve
Genital branch of genitofemoral nerve
Inguinal ligament

Fig. 10.36 Inguinal region. Note the genital branch of the genitofemoral nerve.

ANATOMY **NOTE**

In the female, the *round ligament* of the uterus replaces the spermatic cord in the inguinal canal. The fascia covering the spermatic cord, and specifically its superolateral aspect, is named the *cremasteric fascia.*

- Incise the external spermatic fascia, formed by the external abdominal oblique muscle.
- Trace the pampiniform venous plexus, and incise the cremasteric fascia, derived from the internal oblique muscle.
- Dissect the deepest fascial layer of the spermatic cord, the *internal spermatic fascia,* formed from the fascia of the transversus abdominis muscle, and identify the ductus deferens (Fig. 10.37, Plate 10.3).
- Identify the cremasteric artery (Fig. 10.38).
- Continue the incision of the external spermatic fascia to the scrotum and expose the testis in the scrotal sac.
- Lift the spermatic cord and liberate the testis from the scrotum (Fig. 10.39).

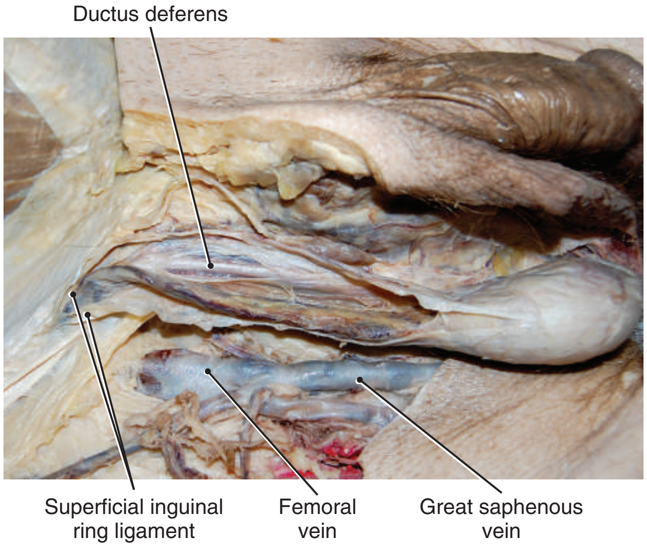
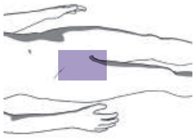

Ductus deferens
Superficial inguinal ring ligament
Femoral vein
Great saphenous vein

Fig. 10.37 With deeper dissection within spermatic cord, note the ductus deferens.



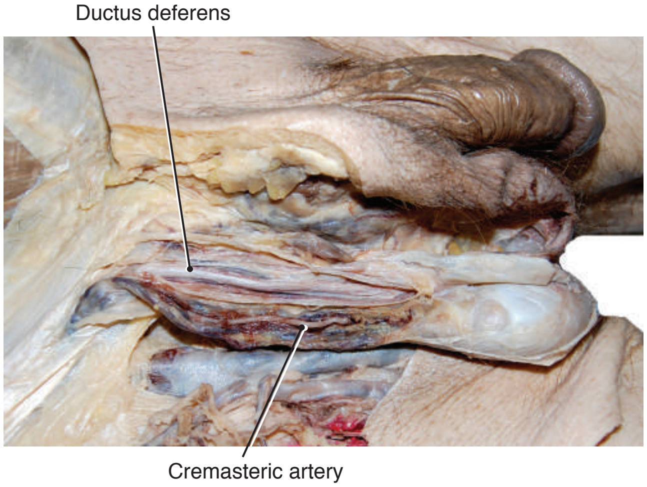
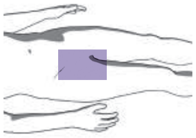

Ductus deferens
Cremasteric artery

Fig. 10.38 Inguinal region in the male showing cremasteric artery.



- Note the outermost layer, called the parietal layer, and the inner, visceral layer of the tunica vaginalis, connecting the epididymis to the testis (with a distinct fold).
- Identify the epididymis, and note its head, body, and tail (see Fig. 10.39).
- Hold the testis and with a scalpel make a longitudinal incision to open (Fig. 10.40).
- Identify the dense capsule of the testis, the *tunica albuginea,* and the septae, which arise from the capsule and divide the testis into several compartments.

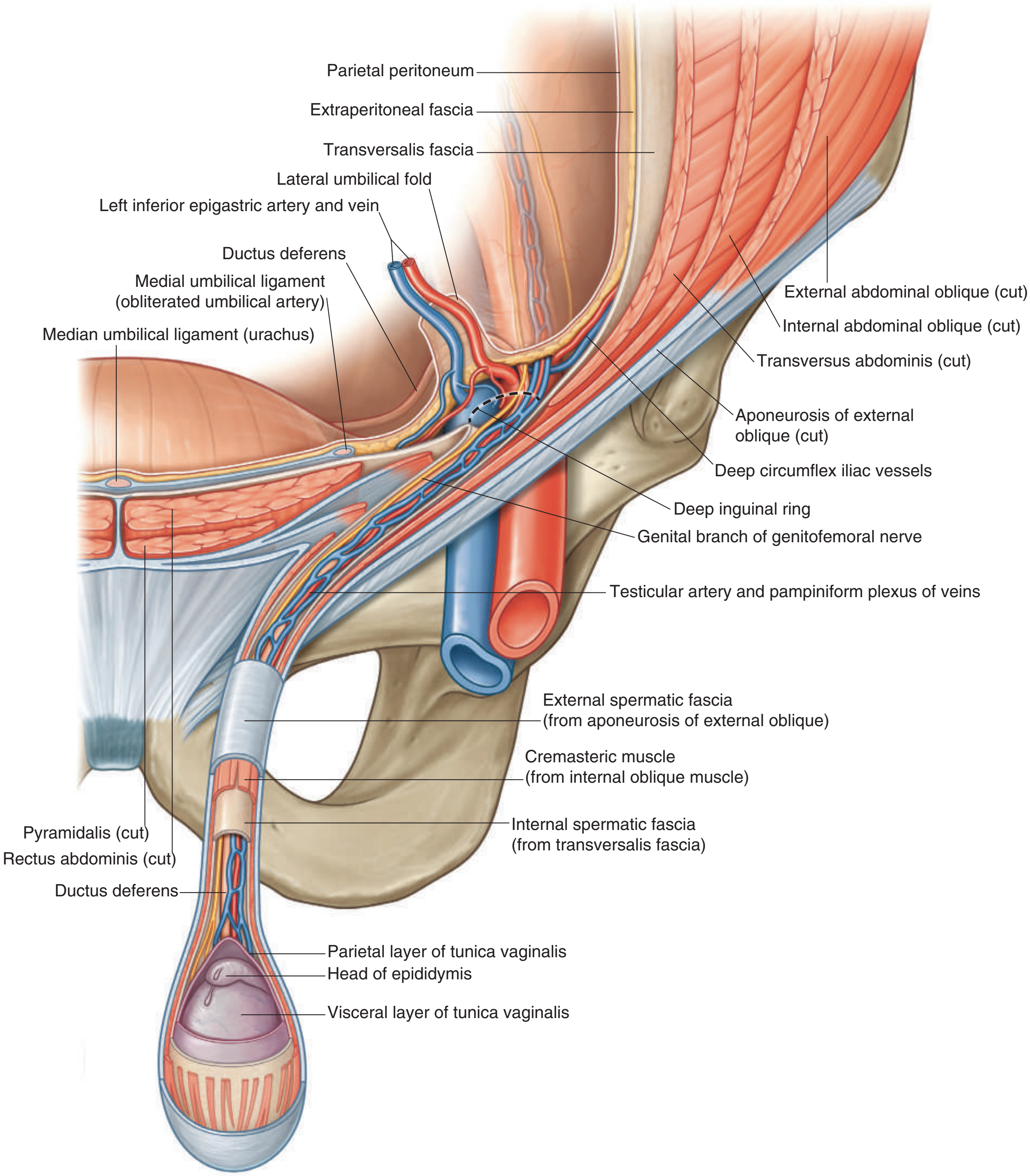

Parietal peritoneum
Extraperitoneal fascia
Transversalis fascia
Lateral umbilical fold
Left inferior epigastric artery and vein
Ductus deferens
Medial umbilical ligament (obliterated umbilical artery)
Median umbilical ligament (urachus)
External abdominal oblique (cut)
Internal abdominal oblique (cut)
Transversus abdominis (cut)
Aponeurosis of external oblique (cut)
Deep circumflex iliac vessels
Deep inguinal ring
Genital branch of genitofemoral nerve
Testicular artery and pampiniform plexus of veins
External spermatic fascia (from aponeurosis of external oblique)
Cremasteric muscle (from internal oblique muscle)
Internal spermatic fascia (from transversalis fascia)
Pyramidalis (cut)
Rectus abdominis (cut)
Ductus deferens
Parietal layer of tunica vaginalis
Head of epididymis
Visceral layer of tunica vaginalis

Plate 10.3 Inguinal canal and contents of spermatic cord.

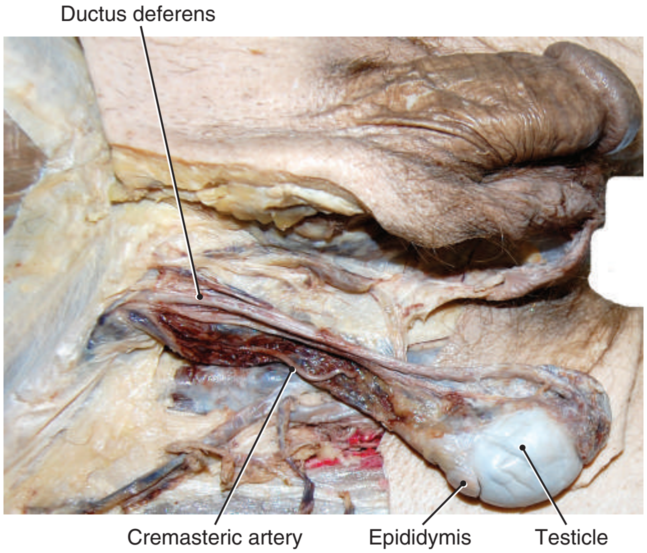
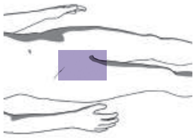


Fig. 10.39 Inguinal region showing epididymis and its relationship to ductus deferens.



DISSECTION **TIP**

If you dissect a female cadaver, identify the round ligament of the uterus.

ANATOMY **NOTE**

The round ligament (ligamentum teres) of the uterus is a fibrous cord traveling from the uterus through the inguinal canal to attach to the labia majora. Identify the round ligament at the superficial ring, and follow it toward the labia majora.

- Cut the skin covering the penis.
- Continue to remove fat and skin over the pubic symphysis and the penis.
- Identify the superficial dorsal vein of the penis embedded in the superficial fascia of the penis (Fig. 10.41).
- Dissect out and reflect the superficial fascia of the penis laterally (Fig. 10.42).
- Notice the deep fascia, *Buck's fascia,* of the penis deep to the superficial fascia.
- On the dorsal surface of the penis, note the separation between the superficial and deep dorsal veins of the penis by Buck's fascia (Fig. 10.43).
- Separate Buck's fascia and identify the dorsal artery of the penis, which is located bilaterally on the dorsum of the penis medial to the dorsal nerves of the penis (Fig. 10.44).

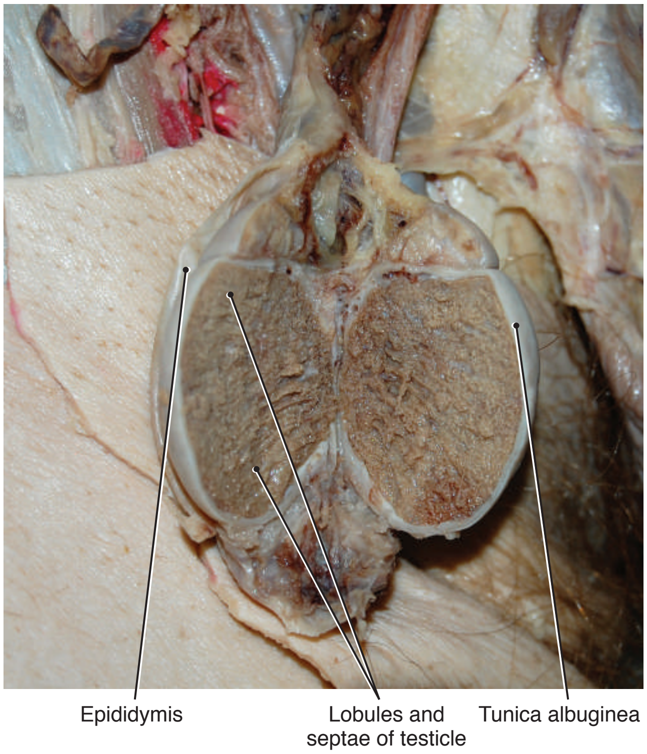
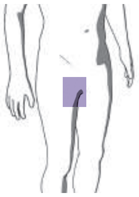


Fig. 10.40 Coronal section through proximal testis noting its layers and components.



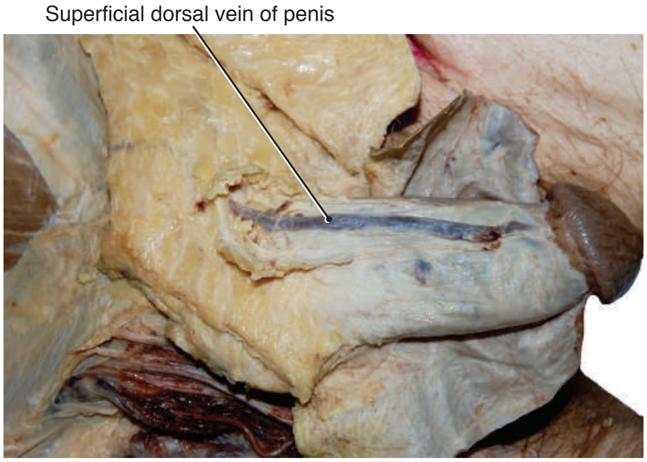
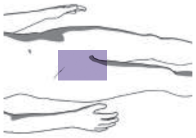

Superficial dorsal vein of penis

Fig. 10.41 Deeper dissection of dorsal penis shows superficial dorsal vein of penis.



- Continue the removal of the fat toward the pubic symphysis and expose the fundiform ligament of the penis arising from the superficial fascia (Fig. 10.45).
- Insert scissors or a probe into the superficial ring just underneath the tendon of the external abdominal oblique muscle, directed toward the anterior superior iliac spine (Fig. 10.46).

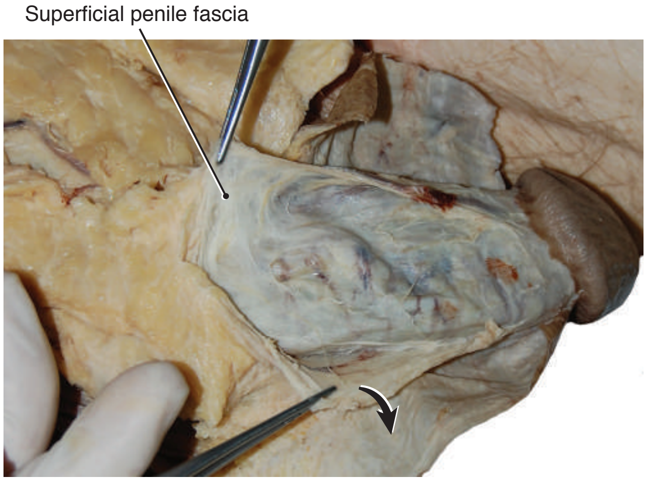
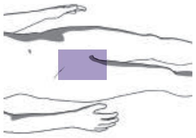

Superficial penile fascia

Fig. 10.42 Dorsal view of penis and its related fascia.



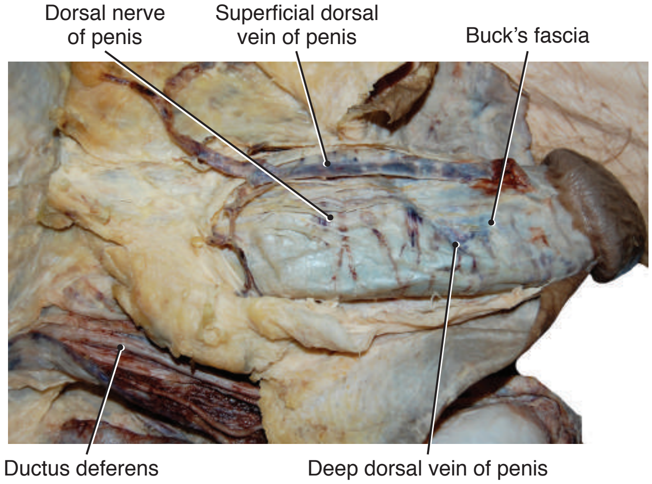
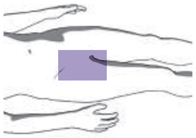

Dorsal nerve of penis
Superficial dorsal vein of penis
Buck's fascia
Ductus deferens
Deep dorsal vein of penis

Fig. 10.43 Dorsal view of penis showing relationship between superficial and deep fasciae. Note position of superficial dorsal vein of penis.



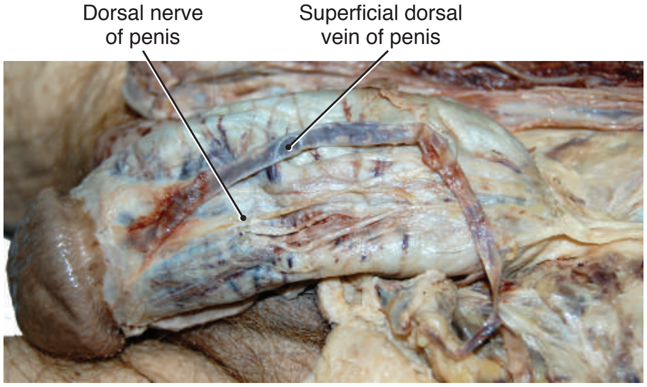
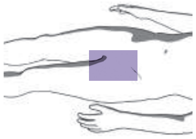

Dorsal nerve of penis
Superficial dorsal vein of penis

Fig. 10.44 Dorsal view of penis with deeper dissection, showing underlying dorsal nerve of penis and its branches.



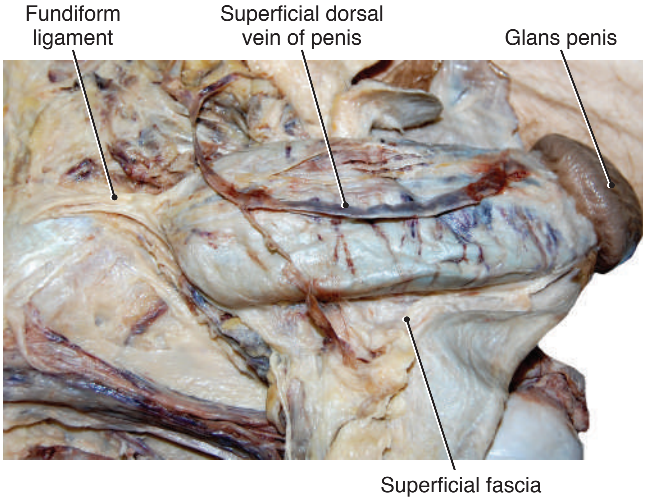
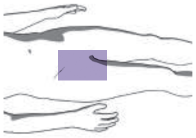

Fundiform ligament
Superficial dorsal vein of penis
Glans penis
Superficial fascia

Fig. 10.45 Dorsal view of penis showing relationship between fundiform ligament and penis.



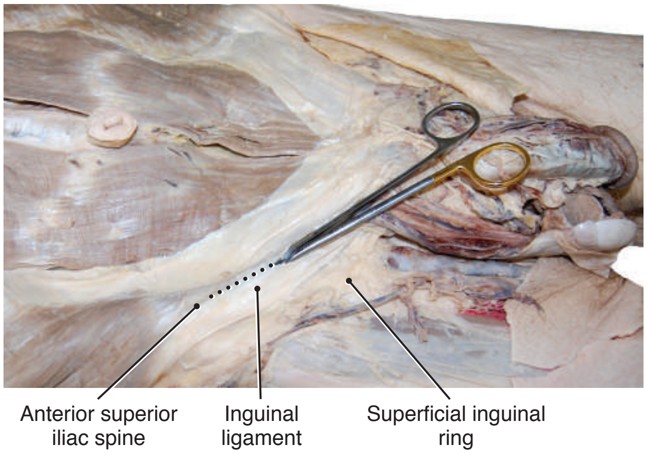
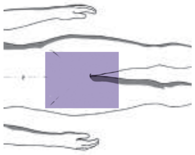

Anterior superior iliac spine
Inguinal ligament
Superficial inguinal ring

Fig. 10.46 The superficial inguinal ring is opened, revealing deeper structures of the inguinal canal.



- **Incise the inguinal ligament over the probe or scissors that was previously inserted, and reflect its borders laterally (Fig. 10.47).**
- **Pull the spermatic cord laterally and expose the lacunar ligament (Gimbernat's ligament), which represents the medial triangular expansion of the inguinal ligament to the pectineal line of the pubis (Figs. 10.48 and 10.49).**
- **Locate the pectineal ligament (Cooper's ligament), which is a strong fibrous band that extends laterally from the lacunar ligament along the pectineal line of the pubis (see Figs. 10.48 and 10.49).**

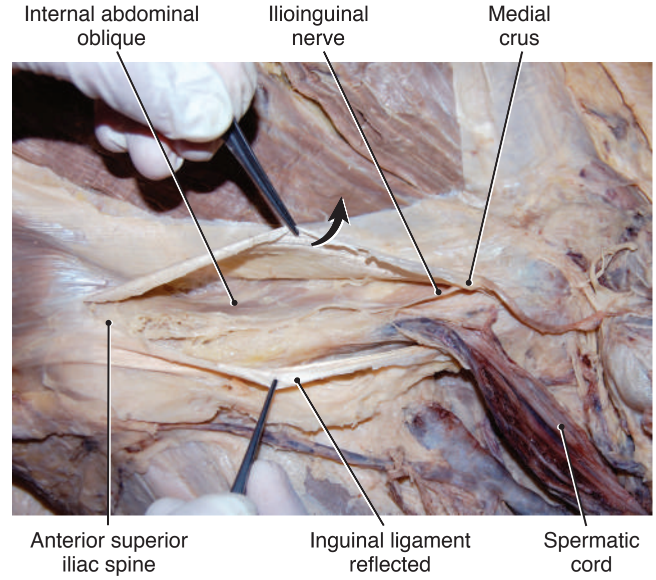
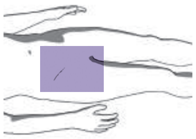

Internal abdominal oblique
Ilioinguinal nerve
Medial crus
Anterior superior iliac spine
Inguinal ligament reflected
Spermatic cord

Fig. 10.47 Inguinal region on right side, showing exposed inguinal canal and its contents.



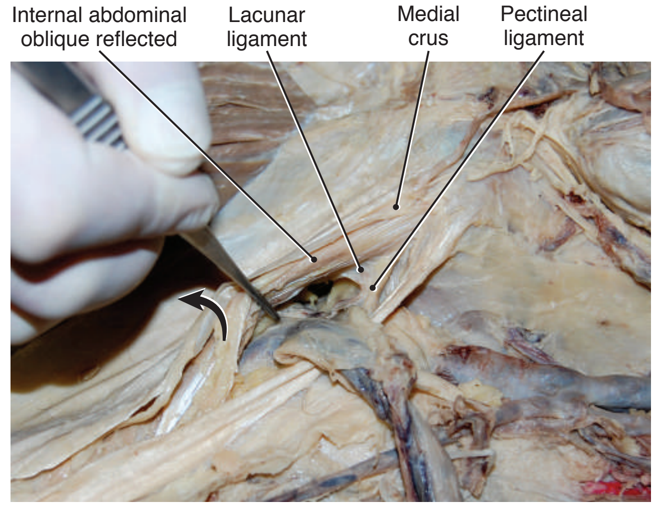
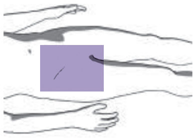

Internal abdominal oblique reflected
Lacunar ligament
Medial crus
Pectineal ligament

Fig. 10.49 Inguinal region on right side, showing specializations of inguinal ligament, the lacunar and pectineal ligaments.



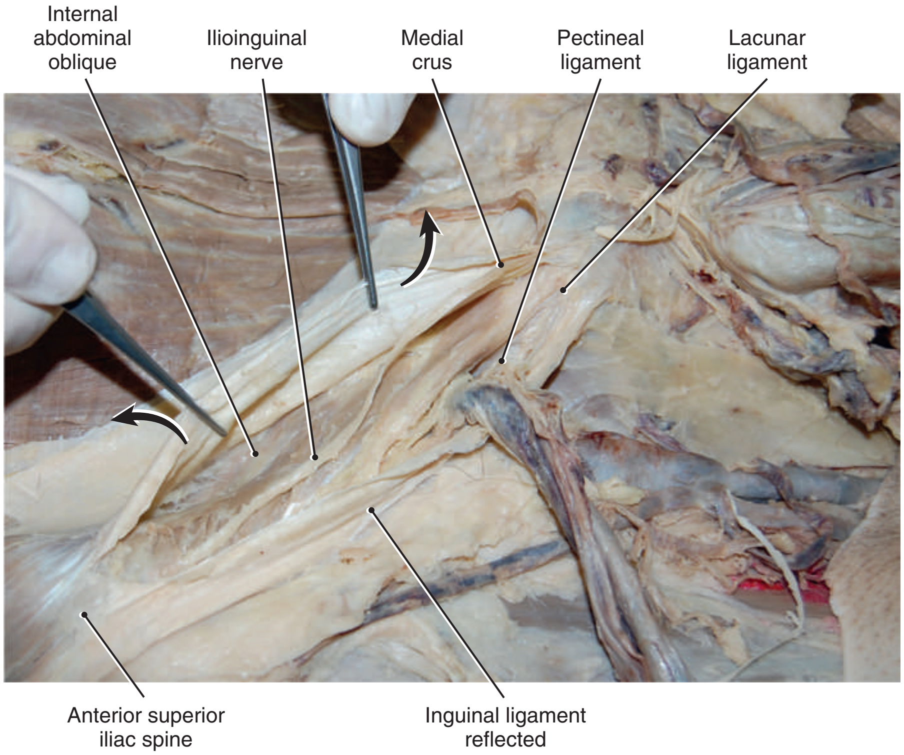
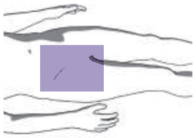

Internal abdominal oblique
Ilioinguinal nerve
Medial crus
Pectineal ligament
Lacunar ligament
Anterior superior iliac spine
Inguinal ligament reflected

Fig. 10.48 Inguinal region on right side. Note specializations of inguinal ligament—the lacunar and pectineal ligaments.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Iliohypogastric
- ☐ Ilioinguinal
- ☐ Genitofemoral
  - ☐ Genital branch
  - ☐ Femoral branch
- ☐ Dorsal, of penis
- ☐ Femoral

ARTERY

- ☐ Cremasteric
- ☐ Inferior epigastric

VEINS

- ☐ Inferior epigastric
- ☐ Superficial external pudendal
- ☐ Superficial dorsal, of penis
- ☐ Femoral
- ☐ Great saphenous

MUSCLES

- ☐ External abdominal oblique
  - ☐ External oblique aponeurosis
- ☐ Internal oblique
- ☐ Cremasteric
- ☐ Transversus abdominis
- ☐ Rectus abdominis
  - ☐ Tendinous intersections
  - ☐ Linea alba

BONES

- ☐ Pubis
  - ☐ Pubic tubercle
  - ☐ Pubic crest
- ☐ Ischium
- ☐ Ilium
  - ☐ Anterior superior iliac spine

LIGAMENTS

- ☐ Inguinal
  - ☐ Superficial ring
  - ☐ Deep ring
- ☐ Lacunar
- ☐ Pectineal
- ☐ Fundiform

FASCIA

- ☐ Superficial
  - ☐ Fatty or Camper's layer
  - ☐ Membranous or Scarpa's layer
- ☐ External spermatic
- ☐ Cremasteric
- ☐ Superficial, of penis
- ☐ Deep, of penis

OTHER STRUCTURES

- ☐ Spermatic cord
- ☐ Testes
  - ☐ Lobules
  - ☐ Septae
- ☐ Epididymis
- ☐ Ductus deferens
- ☐ Tunica vaginalis
- ☐ Tunica albuginea

CHAPTER 11 PERITONEAL CAVITY

ATLAS REFERENCES

Netter: 270–273, 276, 280, 284
McMinn: 226–233, 244, 249
Gray's Atlas: 152–156, 159, 164, 166–168, 172

THREE DIFFERENT TECHNIQUES FOR OPENING THE PERITONEAL CAVITY

DISSECTION TIP

All cuts with the scalpel should be made carefully to avoid cutting too deeply into the peritoneal cavity and underlying viscera.

Technique 1

- After removal of the skin over the anterior abdominal wall, palpate the most inferior costal cartilages and the xiphoid process (Fig. 11.1).
- With scissors or a scalpel, cut the attachments of the rectus abdominis and external abdominal oblique muscles over the right and left hypochondriac areas (Fig. 11.2).
- Continue the incision of the muscles from the xiphoid process toward the midaxillary line on both sides of the cadaver (Fig. 11.3).
- Reflect the rectus abdominis and abdominal oblique muscles inferiorly (Fig. 11.4).

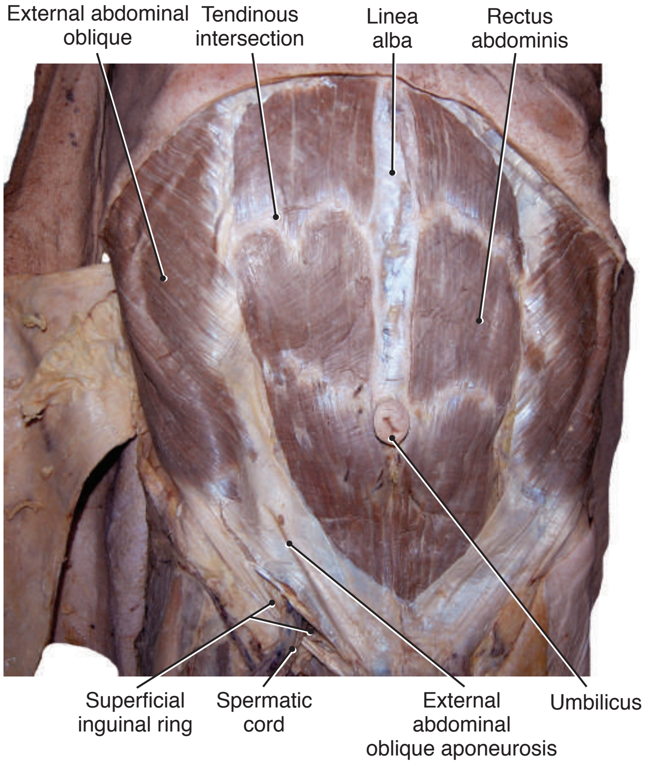
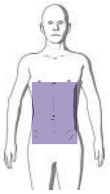

External abdominal oblique
Tendinous intersection
Linea alba
Rectus abdominis
Superficial inguinal ring
Spermatic cord
External abdominal oblique aponeurosis
Umbilicus

Fig. 11.1 Anterior abdomen with skin and subcutaneous tissue reflected revealing rectus abdominis and external oblique muscles.



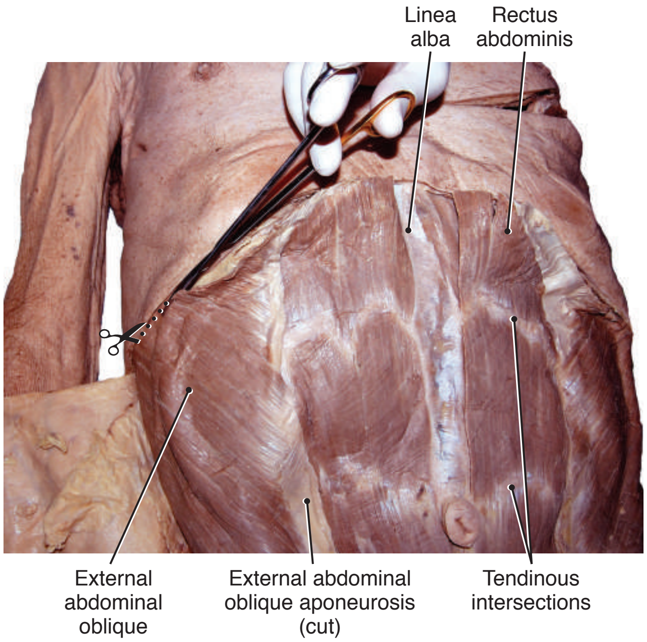

Linea alba
Rectus abdominis
External abdominal oblique
External abdominal oblique aponeurosis (cut)
Tendinous intersections

Fig. 11.2 Attachments of rectus abdominis and external oblique muscles incised over right and left hypochondriac areas.

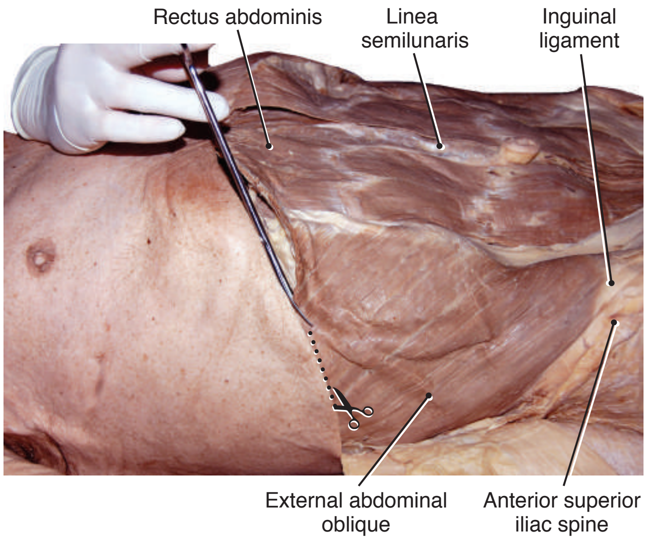

Rectus abdominis
Linea semilunaris
Inguinal ligament
External abdominal oblique
Anterior superior iliac spine

Fig. 11.3 Incision of the muscles from xiphoid process to midaxillary line on both sides.

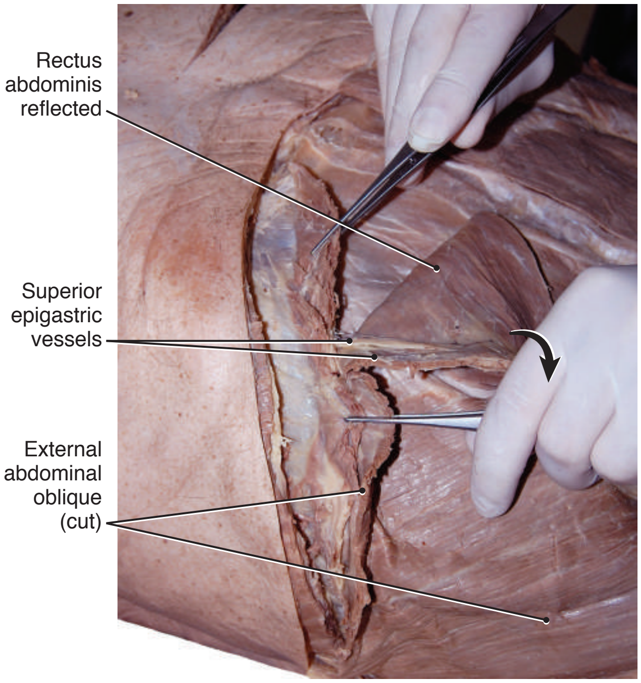
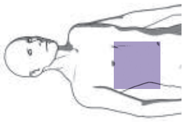

Rectus abdominis reflected
Superior epigastric vessels
External abdominal oblique (cut)

Fig. 11.4 Rectus abdominis and abdominal oblique muscles reflected inferiorly.



- When necessary, use blunt dissection to expose the peritoneal cavity (Fig. 11.5).
- Cut the attachments of the diaphragm, falciform ligament, and ligamentum teres (round ligament) of the liver to the abdominal wall.
- Reflect the anterior abdominal wall toward the pubic symphysis, and observe the contents of the abdominal cavity (Figs. 11.6 and 11.7).

Technique 2

- Reflect the rectus sheath and expose the rectus abdominis muscle and the posterior lamina of the rectus sheath (Figs. 11.8 and 11.9).
- Make a midline vertical incision at the linea alba from the xiphoid process to the pubic symphysis.
- Make a second horizontal incision from the xiphoid process to the midaxillary line, and reflect the muscle flap laterally (Fig. 11.10).
- Use the same technique on the contralateral side, and expose the peritoneal cavity (Fig. 11.11).

Technique 3

- Make a midline vertical incision on the linea alba from the xiphoid process to the pubic symphysis.
- Make a second horizontal incision from the right to the left midaxillary line, passing through the umbilicus, and laterally reflect the four muscle flaps (Fig. 11.12).
- Identify and cut the falciform and round ligaments on the anterior surface of the liver.

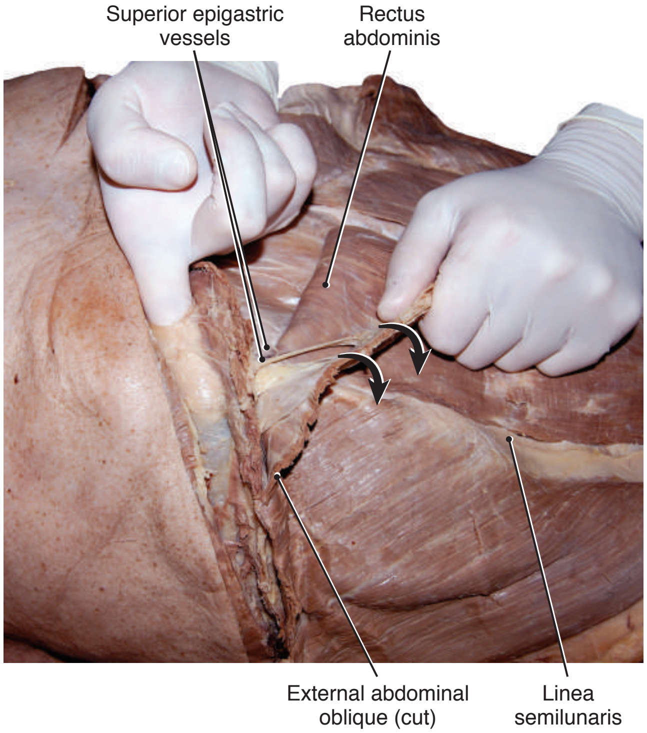
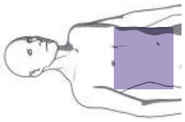

Superior epigastric vessels
Rectus abdominis
External abdominal oblique (cut)
Linea semilunaris

Fig. 11.5 Blunt dissection to expose peritoneal cavity.



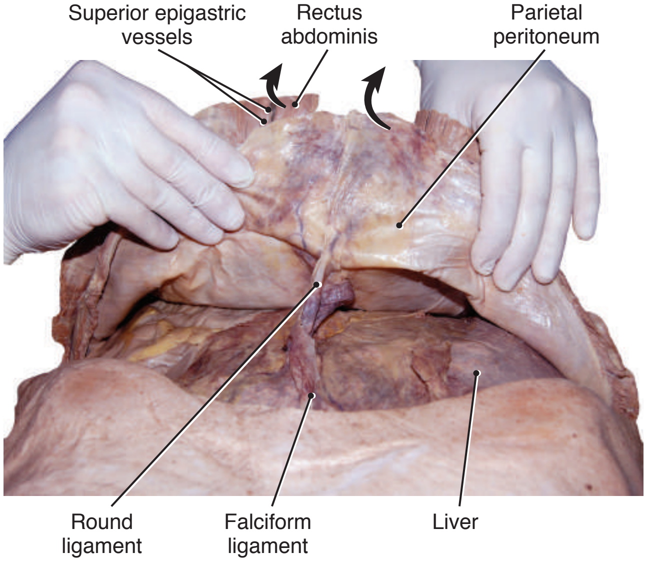

Superior epigastric vessels
Rectus abdominis
Parietal peritoneum
Round ligament
Falciform ligament
Liver

Fig. 11.6 Attachments of the diaphragm, falciform ligament, and round ligament of the liver incised at abdominal wall, with anterior abdominal wall reflected toward pubic symphysis.

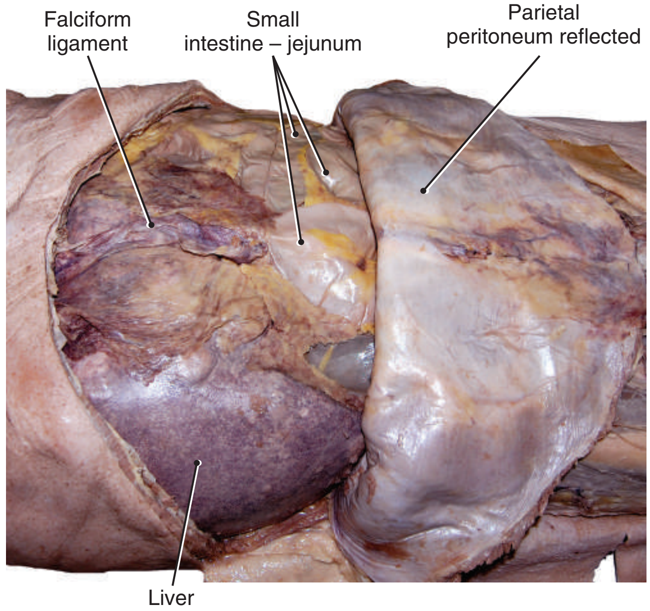
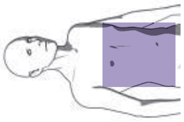

Falciform ligament
Small intestine – jejunum
Parietal peritoneum reflected
Liver

Fig. 11.7 Parietal peritoneum reflected, showing contents of abdomen and anterior abdominal wall.



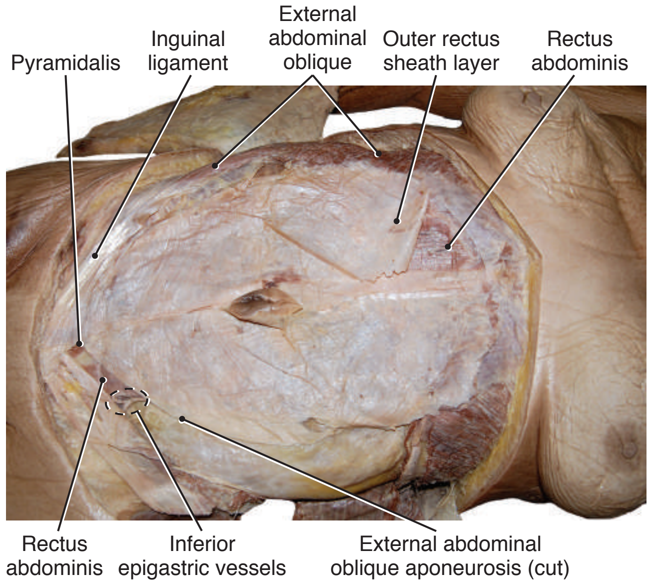
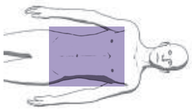

Pyramidalis
Inguinal ligament
External abdominal oblique
Outer rectus sheath layer
Rectus abdominis
Rectus abdominis
Inferior epigastric vessels
External abdominal oblique aponeurosis (cut)

Fig. 11.8 Rectus sheath reflected.



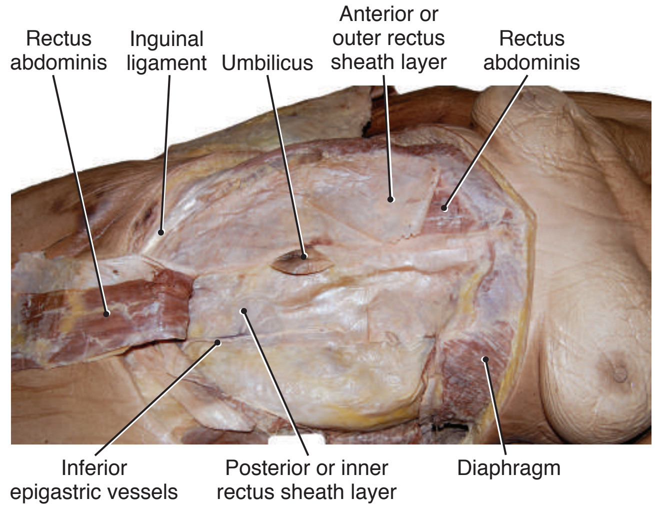
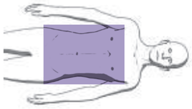

Rectus abdominis
Inguinal ligament
Umbilicus
Anterior or outer rectus sheath layer
Rectus abdominis
Inferior epigastric vessels
Posterior or inner rectus sheath layer
Diaphragm

Fig. 11.9 Observe exposed rectus abdominis muscles and posterior lamina of rectus sheath.



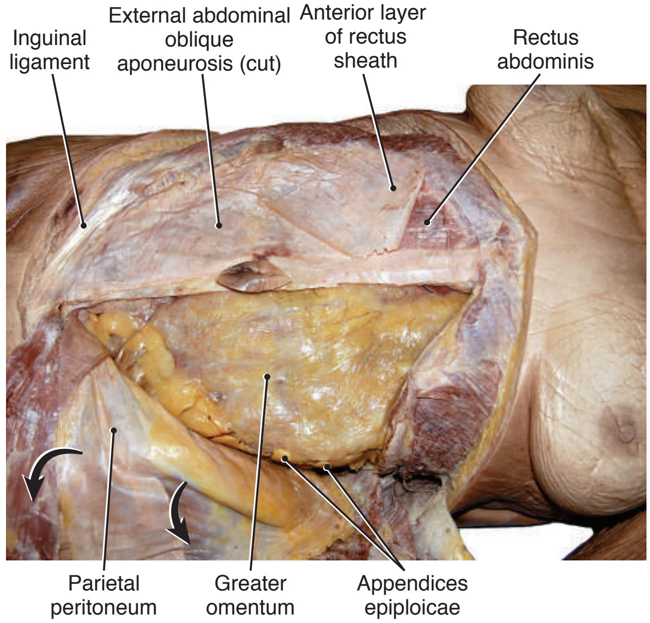
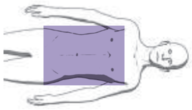

Inguinal ligament
External abdominal oblique aponeurosis (cut)
Anterior layer of rectus sheath
Rectus abdominis
Parietal peritoneum
Greater omentum
Appendices epiploicae

Fig. 11.10 Xiphoid process to pubic symphysis incision.



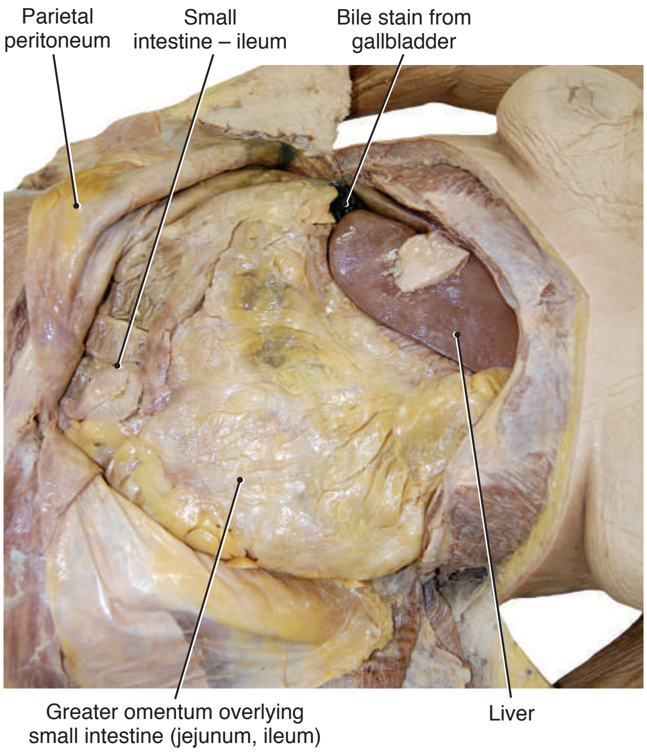
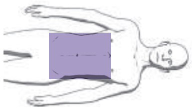

Parietal peritoneum
Small intestine – ileum
Bile stain from gallbladder
Greater omentum overlying small intestine (jejunum, ileum)
Liver

Fig. 11.11 Second horizontal incision from xiphoid process to midaxillary line on both sides with laterally reflected muscle flap.



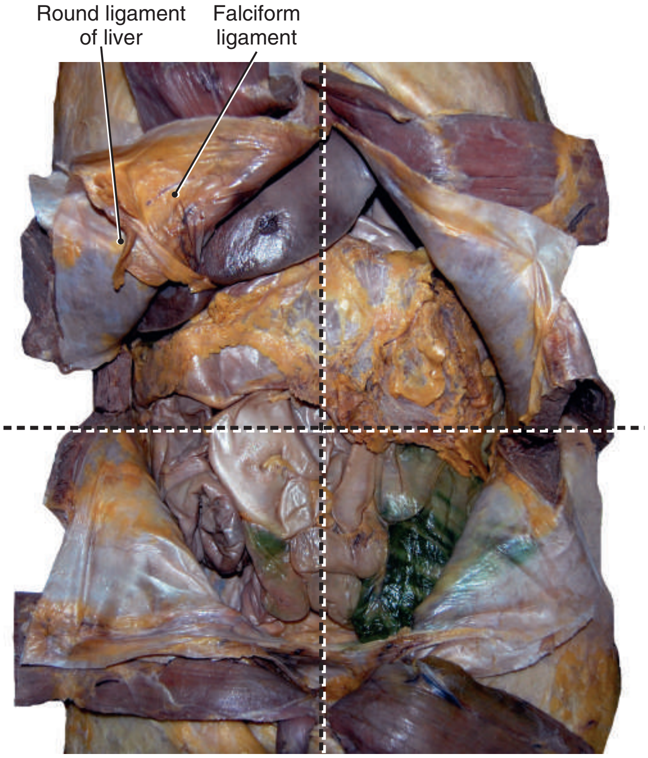
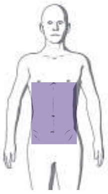


Fig. 11.12 Midline vertical incision at linea alba from xiphoid process to pubic symphysis, with second horizontal incision from right to left midaxillary lines through umbilicus, with four muscle flaps reflected laterally.



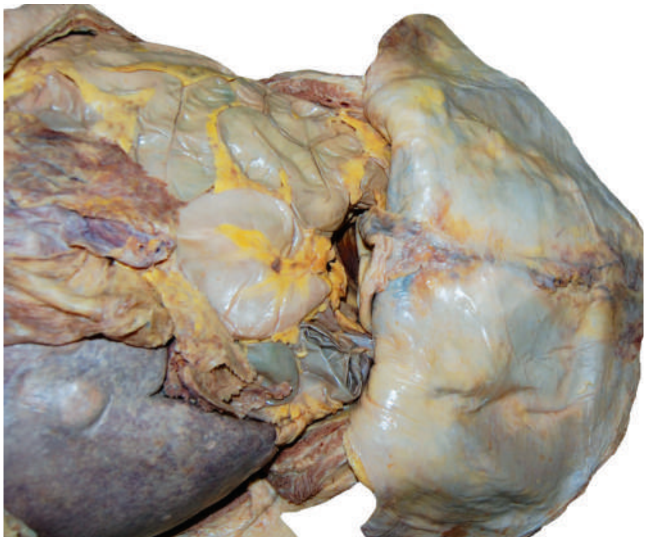
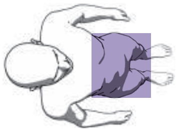


Fig. 11.13 Five peritoneal folds at internal surface of anterior abdominal wall: two lateral folds, two medial folds, and one median umbilical fold.



DISSECTION **TIP**

In some specimens the peritoneal cavity is small. To expose it further, with a saw, cut the ribs in the midaxillary line on both sides of the cadaver. You also may extend the cuts with those made previously to expose the thoracic cavity.

In some cadavers, you will be able to separate the parietal peritoneum from the transversalis fascia. In most, however, these two layers are tightly adherent.

PERITONEAL STRUCTURES

- ○ **Trace the round ligament of the liver along its pathway from the anterior surface of the liver to the median aspect of the anterior abdominal wall to the umbilicus.**
- ○ **At the internal (posterior) surface of the anterior abdominal wall, identify five notable peritoneal folds: the lateral (right and left), the medial (right and left), and the single median umbilical folds (Fig. 11.13).**

ANATOMY **NOTE**

The peritoneal fold covering the inferior epigastric artery and vein is the lateral umbilical peritoneal fold. The medial umbilical folds are formed by an elevation of the peritoneum over the obliterated umbilical arteries. Similarly, the median umbilical fold is an elevation of the peritoneum over the remnants of the urachus (intraabdominal part of allantois). The space between the medial umbilical fold and median umbilical fold is termed the *supravesical fossa.* The depressed region between the medial umbilical fold and the lateral umbilical fold is termed the *medial inguinal fossa.* The lateral inguinal fossa is the area lateral to the lateral inguinal fold.

- **Make an incision at the posterior layer of the rectus sheath (and peritoneum) and expose the rectus abdominis muscle (Fig. 11.14).**
- **Trace the course of the inferior epigastric artery and identify its origin from the external iliac artery (Figs. 11.15 to 11.17).**

DISSECTION **TIP**

In approximately 30% of cadavers, the inferior epigastric artery will give rise to the obturator artery, which travels medially over the pelvic brim.

- **Remove the peritoneum covering the inferior epigastric artery and the base of the rectus abdominis muscle, and identify the inguinal ligament (Fig. 11.18).**

ANATOMY **NOTE**

Notice the triangle of Hesselbach formed by the lateral border of the rectus abdominis muscle, the inguinal ligament, and the inferior epigastric vessels.

- **Laterally to the inferior epigastric artery and vein, identify the deep inguinal ring and the ductus deferens (round ligament in females) passing within it.**

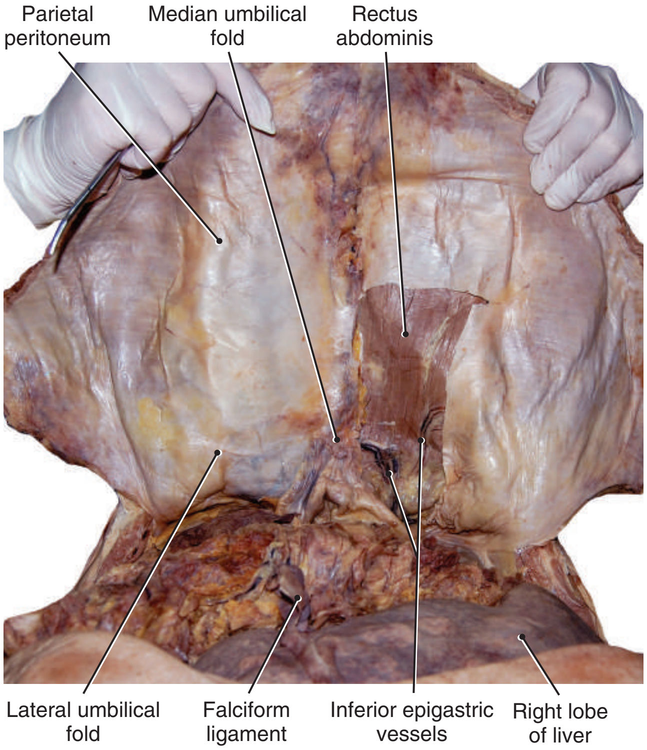

Parietal peritoneum
Median umbilical fold
Rectus abdominis
Lateral umbilical fold
Falciform ligament
Inferior epigastric vessels
Right lobe of liver

Fig. 11.15 Appreciate the inferior epigastric artery and vein, as well as medial and lateral umbilical peritoneal folds.

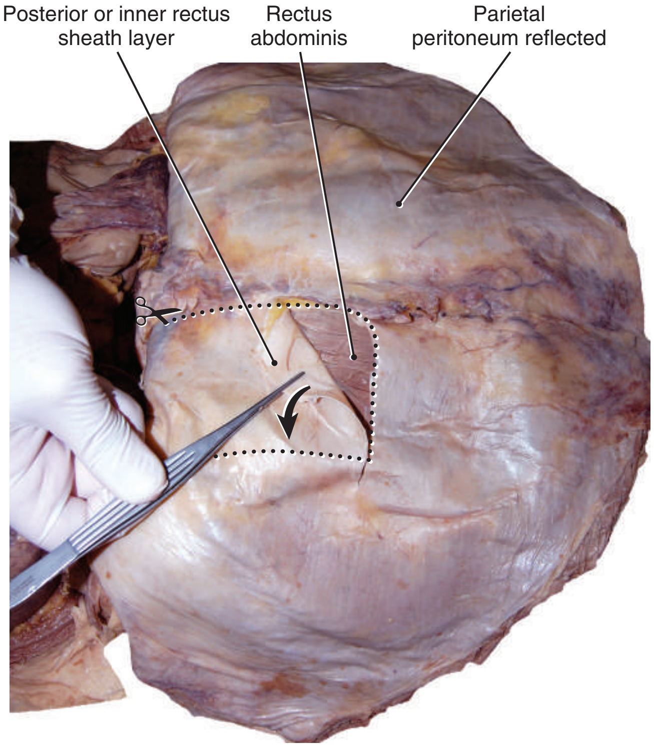
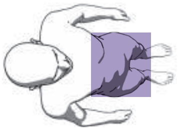

Posterior or inner rectus sheath layer
Rectus abdominis
Parietal peritoneum reflected

Fig. 11.14 Posterior layer of rectus sheath cut exposing rectus abdominis muscle.



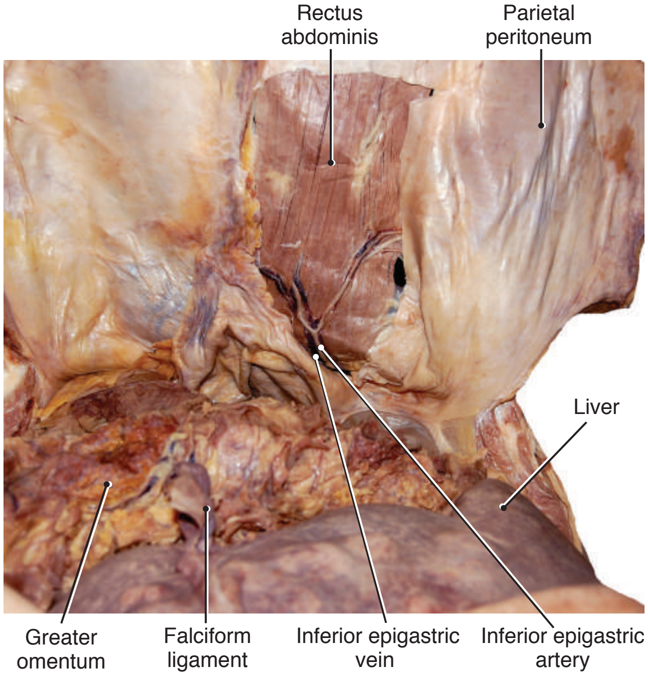

Rectus abdominis
Parietal peritoneum
Liver
Greater omentum
Falciform ligament
Inferior epigastric vein
Inferior epigastric artery

Fig. 11.16 Dissect the inferior epigastric artery and vein.

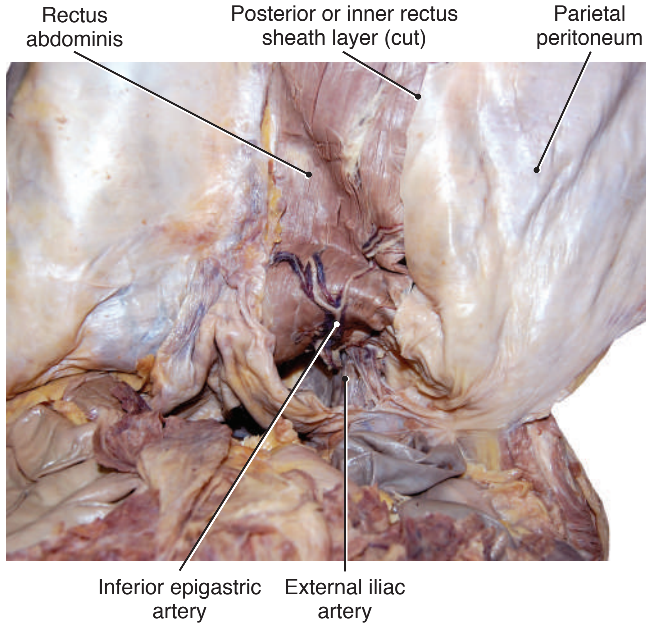

Rectus abdominis
Posterior or inner rectus sheath layer (cut)
Parietal peritoneum
Inferior epigastric artery
External iliac artery

Fig. 11.17 Dissect the inferior epigastric artery where it arises from the external iliac artery.

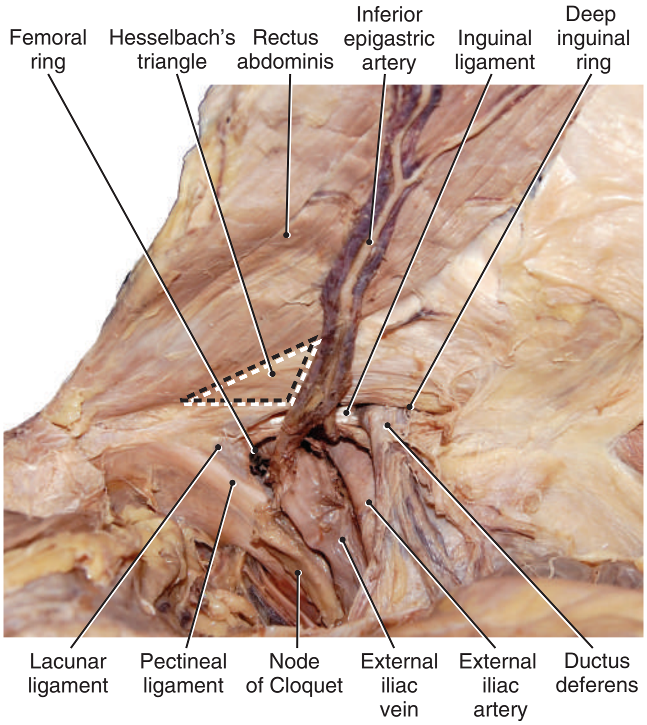

Femoral ring
Hesselbach's triangle
Rectus abdominis
Inferior epigastric artery
Inguinal ligament
Deep inguinal ring
Lacunar ligament
Pectineal ligament
Node of Cloquet
External iliac vein
External iliac artery
Ductus deferens

Fig. 11.18 Dissect the peritoneum covering the inferior epigastric artery and base of the rectus abdominis muscle and identify the inguinal ligament. Continue the dissection by locating the pubic tubercle, and lateral to it, identify the pectineal ligament.

- Continue the dissection by identifying the pubic tubercle and, lateral to it, a strong ligamentous band running over the periosteum of the pectineal line, the *pectineal ligament* (Cooper's ligament) (see Fig. 11.18).
- Note the medial one third of the inguinal ligament forming an aponeurotic expansion attaching to the pectineal line of the pubis and pectineal ligament, the *lacunar ligament* (Gimbernat's ligament) (see Fig. 11.18).
- Lateral to the lacunar ligament, expose the femoral vessels, and identify the *femoral ring* (lying medial to the femoral vein), the opening to the femoral canal.

DISSECTION **TIP**

Clean the adipose tissue and look for a large lymph node, the *node of Cloquet*.

- Retract the femoral vein medially and note a fascial partition under the inguinal ligament between the femoral vein and the iliopsoas muscle. This partition between the vascular portion (lacuna vasorum) and the muscular portion (lacuna musculorum) is called the *iliopectineal ligament* (see Fig. 11.18).
- Inspect the contents of the peritoneal cavity, and identify the liver, stomach (with its greater and lesser curvatures), small and large intestines, and greater omentum (Fig. 11.19).

ANATOMY **NOTE**

The peritoneal cavity is traditionally divided into two parts, the greater and lesser sacs, or into supracolic and infracolic compartments. The *greater sac* is the entire area of the peritoneal cavity with the exception of the area extending behind the stomach to the diaphragm at the left side, which is the *lesser sac* (omental bursa). Similarly, the *supracolic compartment* is the area of the peritoneal cavity that extends from the transverse mesocolon to the diaphragm. The *infracolic compartment* is the area of the peritoneal cavity extending from the transverse mesocolon below to the pelvic brim.

- Identify the greater curvature of the stomach, and lift the greater omentum (Fig. 11.20).
- Expose the transverse colon with its transverse mesocolon, and identify the ileum, jejunum, cecum, ascending colon, transverse colon, and descending sigmoid colon (Fig. 11.21).
- Observe the space between the liver and the stomach and identify the gallbladder and lesser omentum (Fig. 11.22).
- With blunt dissection using your fingertips, separate any adhesions between the stomach and the liver (Fig. 11.23).

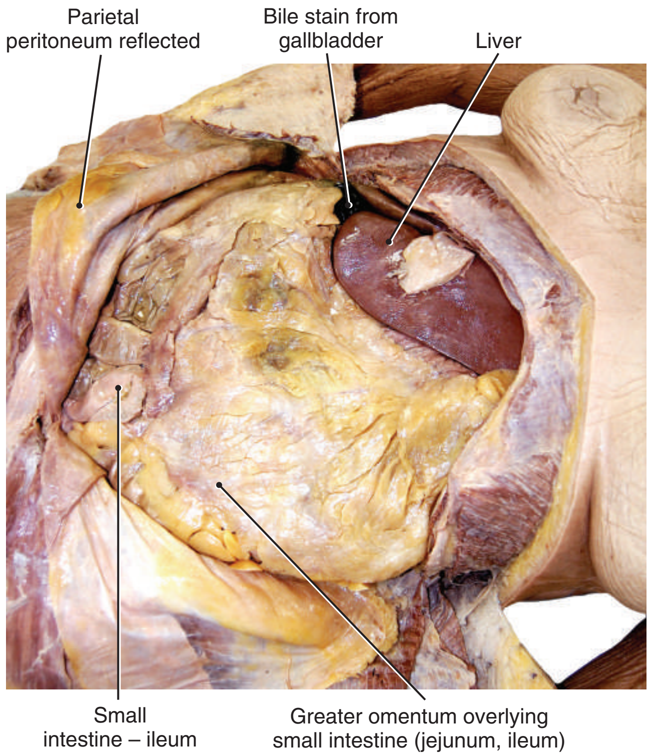
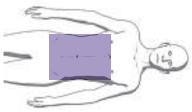

Parietal peritoneum reflected
Bile stain from gallbladder
Liver
Small intestine – ileum
Greater omentum overlying small intestine (jejunum, ileum)

Fig. 11.19 Appreciate the liver, stomach, small and large intestines, and greater omentum.



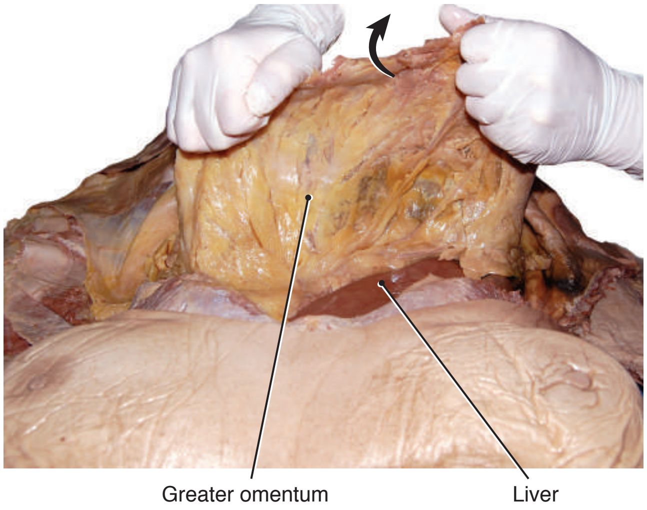

Greater omentum
Liver

Fig. 11.20 Lift the greater omentum at the greater curvature of stomach.

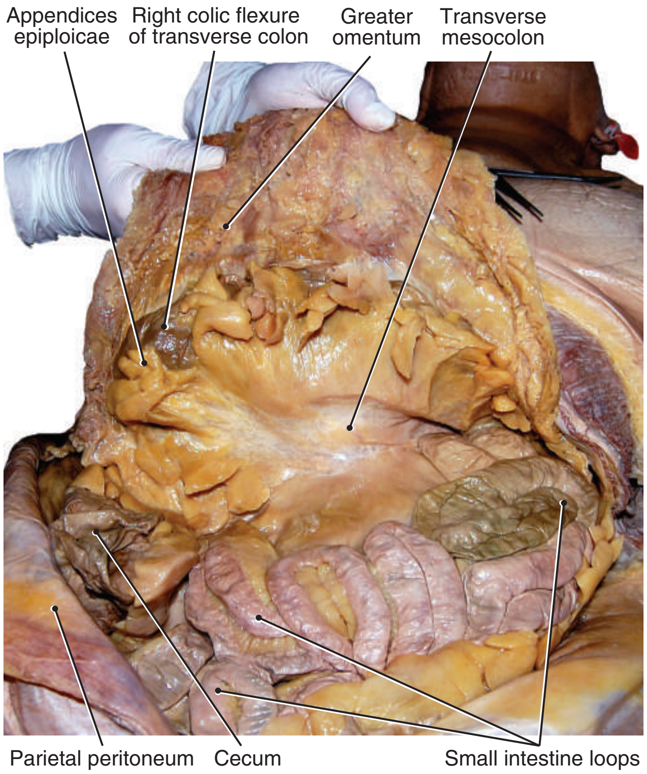
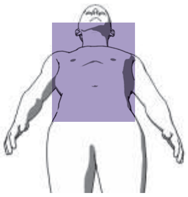

Appendices epiploicae
Right colic flexure of transverse colon
Greater omentum
Transverse mesocolon
Parietal peritoneum
Cecum
Small intestine loops

Fig. 11.21 Expose and locate the transverse colon and mesocolon.



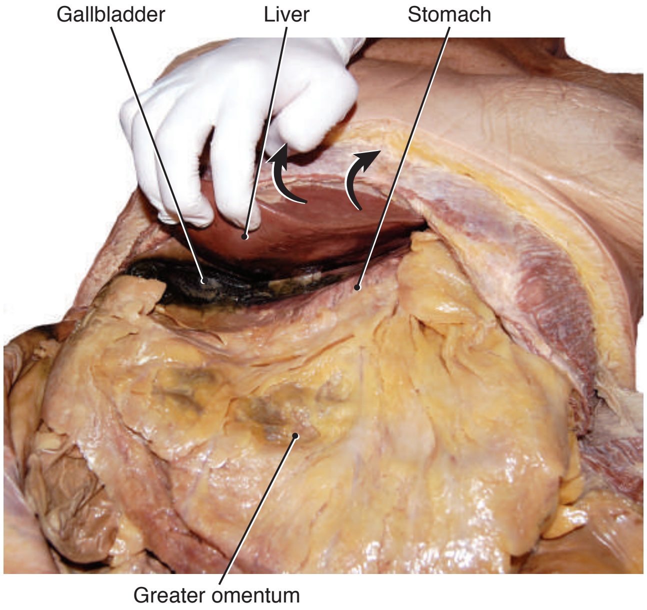
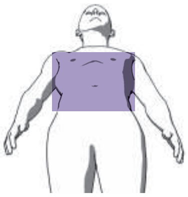

Gallbladder
Liver
Stomach
Greater omentum

Fig. 11.22 Locate the space between the liver and stomach and identify the gallbladder and lesser omentum.



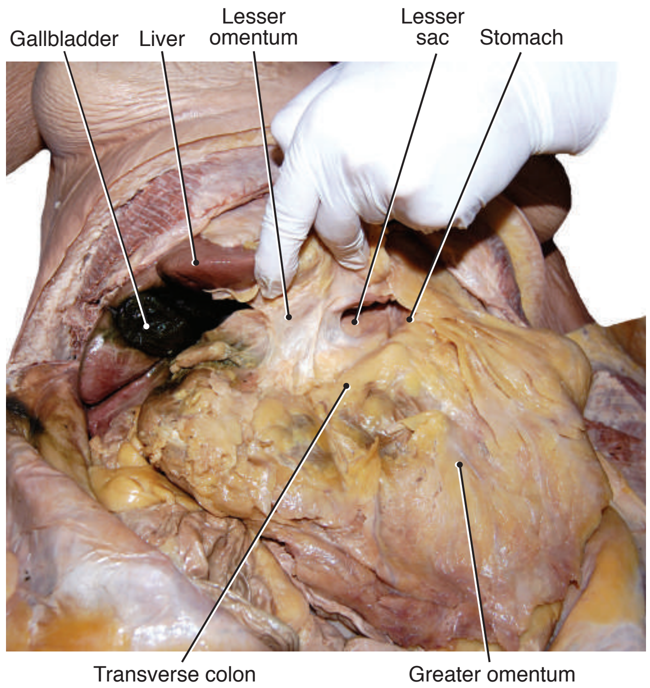
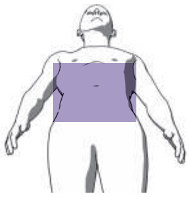

Gallbladder
Liver
Lesser omentum
Lesser sac
Stomach
Transverse colon
Greater omentum

Fig. 11.23 Continue the blunt dissection with your fingers.



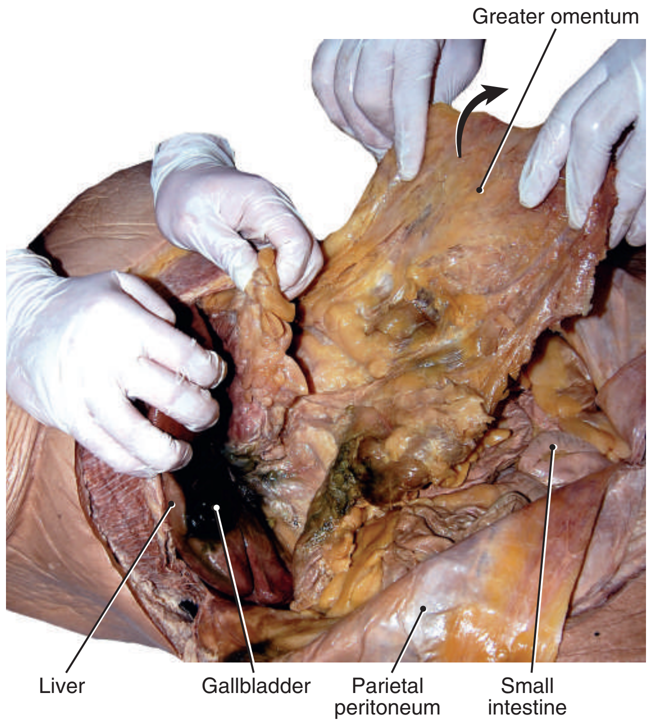
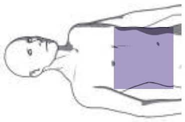

Greater omentum
Liver
Gallbladder
Parietal peritoneum
Small intestine

Fig. 11.24 Cut the greater omentum approximately 3 cm from the greater curvature of stomach, but do *not* cut its connection with the transverse colon.



DISSECTION **TIP**

Often you will find several adhesions between the contents of the peritoneal cavity. Take some time and separate these adhesions to restore the normal anatomy and position of the organs.

- Cut the greater omentum 3 to 4 cm away from the greater curvature, and leave its attachments to the transverse colon (Fig. 11.24).
- Pull the stomach away from the transverse colon, and note the area of the lesser sac. Also notice the pancreas lying directly behind the stomach (Fig. 11.25).
- Continue the dissection by pulling the stomach inferiorly from the liver, and note the *epiploic foramen* (of Winslow) (Fig. 11.26).
- Pass a probe or scissors underneath the lesser omentum through the epiploic foramen (Fig. 11.27 and Plate 11.1).

PALPATION AND IDENTIFICATION OF STRUCTURES (WITHOUT DISSECTION)

1. Lesser omentum
2. Epiploic foramen
3. Stomach
4. Gallbladder

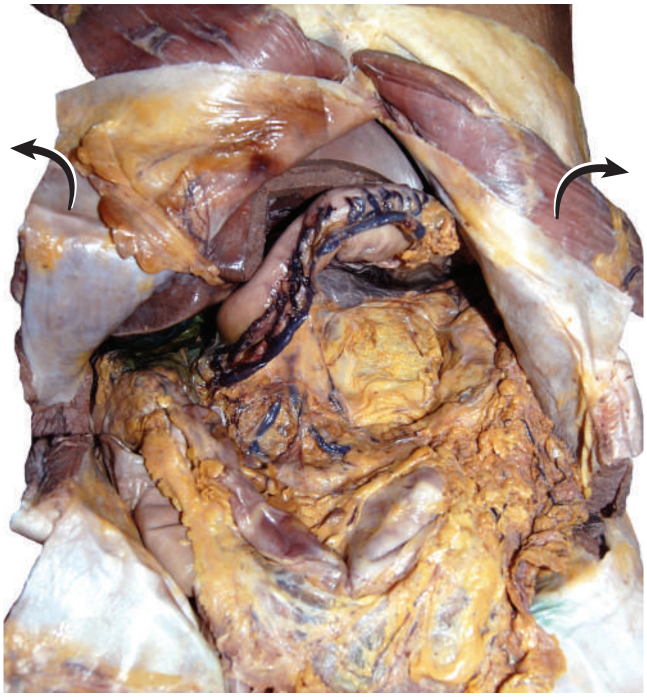
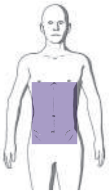


Fig. 11.25 Pull the stomach from the transverse colon to appreciate the lesser sac and pancreas.



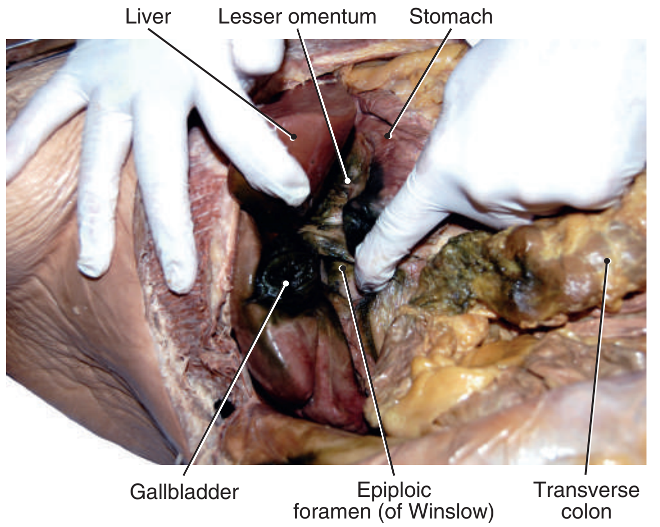
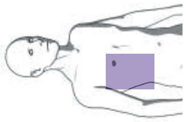


Fig. 11.26 Pull the stomach inferiorly from the liver and locate the epiploic foramen.



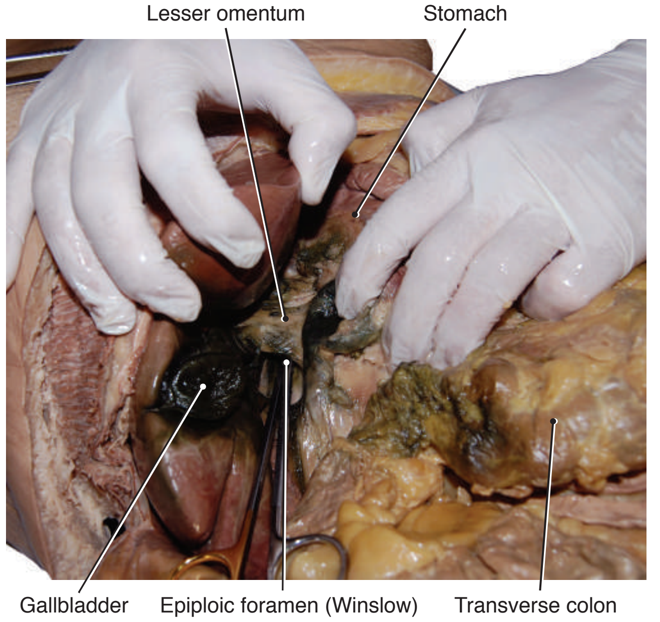
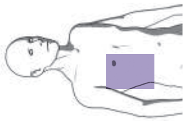


Fig. 11.27 Pass a probe or scissors posterior to the lesser omentum via the epiploic foramen.



5. Spleen
6. Liver
7. Small intestine
8. Large intestine

Lesser Omentum

- The *lesser omentum* includes the hepatogastric and hepatoduodenal ligaments. To distinguish them, note that the *hepatogastric* ligament connects the liver to the stomach, whereas the *hepatoduodenal* ligament connects the liver to the duodenum.

ANATOMY **NOTE**

The hepatoduodenal ligament contains the bile duct, the hepatic artery, and the hepatic portal vein.

Epiploic Foramen

- Place your thumb at the *epiploic foramen* and index finger on top of the hepatoduodenal ligament, and feel for these structures. This is called the *Pringle maneuver* and is useful for controlling hemorrhage from the hepatic artery when accidentally injured.

Stomach

- Palpate the anterior surface of the *stomach* and notice the greater and lesser curvatures, the body, the fundus, and the pyloric sphincter.

DISSECTION **TIP**

Note on neighboring cadavers the variable stomach shapes and sizes, which is a normal feature.

Gallbladder

- Identify the *gallbladder* (if present) at the internal surface of the liver.

DISSECTION **TIP**

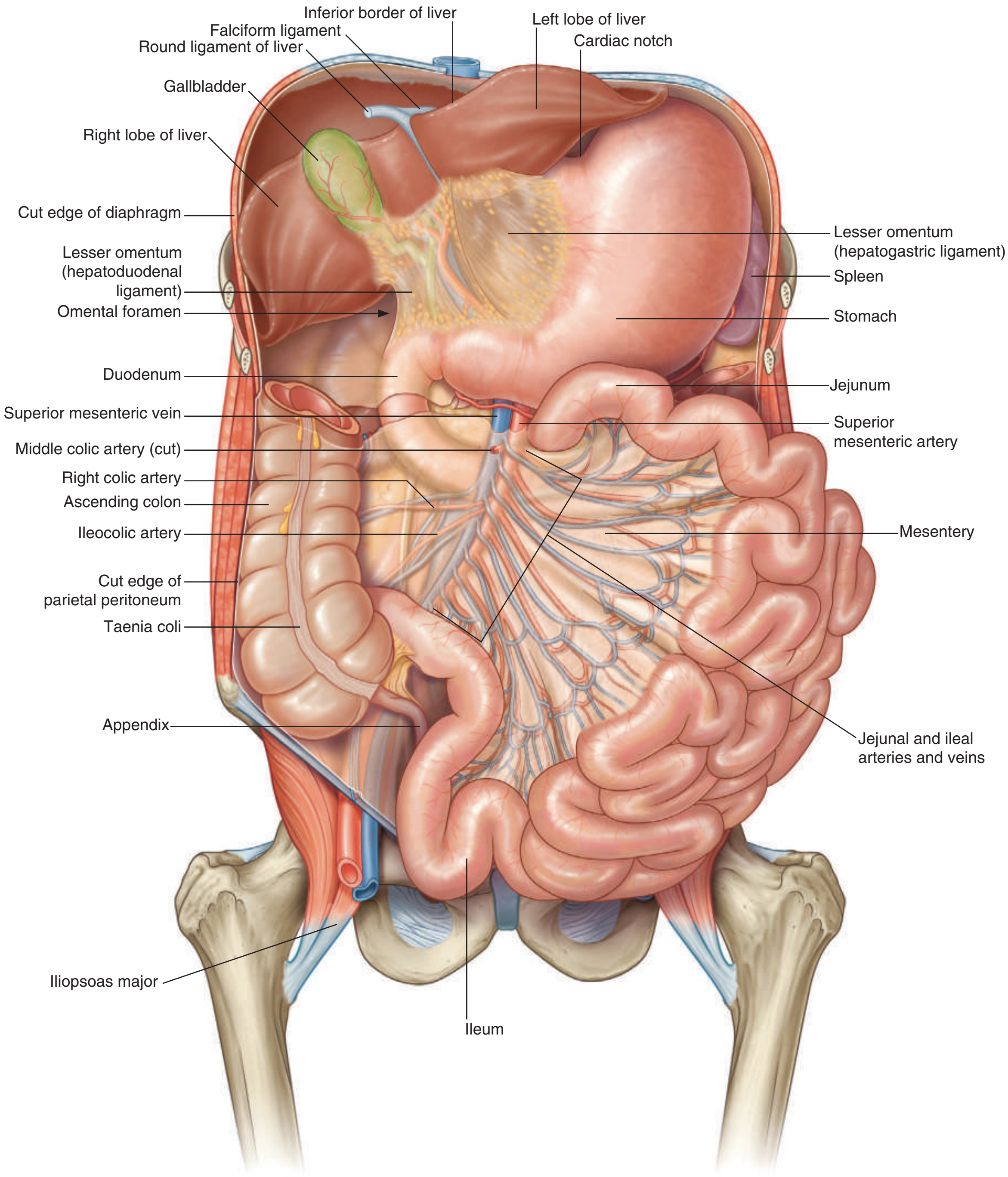
A surgical landmark to identify the gallbladder is the point of intersection between the 9th costal cartilage and the linea semilunaris.

Spleen

- Lift the stomach and pass your fingers posterior to it to reach the spleen. Feel the *gastrosplenic ligament* connecting the greater curvature of the stomach to the spleen.
- Palpate the *spleen,* and with your palm, try to feel the posterior surface of the spleen up against the body wall.

DISSECTION **TIP**

While attempting this maneuver, your palm will come up against the *splenorenal ligament,* which connects the spleen to the body wall. Similarly, if you try to reach the diaphragm, moving your fingertips upward from the spleen, you will feel the *phrenicocolic ligament* connecting the spleen to the diaphragm.


Inferior border of liver
Falciform ligament
Round ligament of liver
Left lobe of liver
Cardiac notch
Gallbladder
Right lobe of liver
Cut edge of diaphragm
Lesser omentum (hepatoduodenal ligament)
Omental foramen
Lesser omentum (hepatogastric ligament)
Spleen
Stomach
Duodenum
Jejunum
Superior mesenteric vein
Superior mesenteric artery
Middle colic artery (cut)
Right colic artery
Ascending colon
Ileocolic artery
Mesentery
Cut edge of parietal peritoneum
Taenia coli
Appendix
Jejunal and ileal arteries and veins
Iliopsoas major
Ileum

Small intestine displaced to show superior mesenteric vessels

Plate 11.1 Lesser omentum.

Liver

- With your fingertips, palpate the *liver,* and identify the falciform, round, and coronary ligaments.

Small Intestine

- Palpate the pyloric sphincter and distal to it, feel for the much softer, 1st portion of the duodenum.
- Lift the greater omentum, and identify the transverse colon with its mesentery, the *transverse mesocolon.*
- Just behind the transverse mesocolon, the 2nd part of the duodenum passes vertically on the right side of the cadaver.
- Identify the mesentery of the ileum and jejunum.
- The mesentery of the ileum and jejunum covers the 3rd (horizontal) part of the duodenum.
- Identify the final, 4th part, of the duodenum *duodenojejunal flexure.*
- At the duodenojejunal flexure feel for a connective tissue band, the “suspensory ligament of the duodenum” (ligament of Treitz).

- Continue palpating the *jejunum,* which makes up approximately two-fifths of the small intestine.

Large Intestine

- Palpate the distal part of the *ileum* and, in the right lower quadrant of the abdominal cavity, identify the *cecum* and the ileocecal junction.
- Explore the cecum for an attached *appendix.* Notice that the appendix has its own mesentery, the *mesoappendix.*

DISSECTION **TIP**

In most cadavers the appendix originates from the posterior part of the cecum. This is termed a *retrocecal appendix.* In addition, the appendix often has been surgically removed; look for the original location of the appendix, if possible.

- Continue identifying the ascending, transverse, descending, and sigmoid parts of the colon. The rectum and anus will not be identified during this part of dissection.
- Palpate the proximal part of the ascending colon, the *ileocecal junction,* as well as its distal part the right colic or hepatic flexure at the level of the liver.
- At the hepatic flexure, the ascending colon turns left and becomes the transverse colon.
- Similarly, the transverse colon reaches the splenic flexure or left colic flexure, which turns to the right (inferiorly) to become descending colon.
- At the lower lever of the left lower quadrant, the descending colon becomes the sigmoid colon, exhibiting a characteristic S shape. Notice its mesentery, the *sigmoid mesocolon.*

DISSECTION **TIP**

It is difficult to appreciate the entire length of the sigmoid mesocolon and sigmoid colon, because most of it is located within the pelvic cavity. This portion will be identified during a later dissection.

- With your hands, lift and medially pull up the ascending colon and descending colon, and identify the longitudinal depressions; they rest in the right and left paracolic gutters.

DISSECTION **TIP**

The large intestine exhibits some characteristic morphologic features:

- *Teniae coli* are three narrow muscular bands of the external longitudinal muscle layer of the large intestine.
- *Haustra,* or sacculations, are pouches produced by the teniae coli.
- *Appendices epiploicae* are peritoneum-covered fat-filled sacs, attached in rows along the teniae coli.

LABORATORY IDENTIFICATION CHECKLIST

LIGAMENTS

- ☐ Gastrosplenic
- ☐ Hepatogastric
- ☐ Hepatoduodenal
- ☐ Inguinal (Poupart's)
- ☐ Lacunar (Gimbernat's)
- ☐ Pectineal (Cooper's)
- ☐ Median arcuate
- ☐ Medial arcuate
- ☐ Lateral arcuate
- ☐ Median umbilical (urachus)
- ☐ Medial umbilical

LIVER

- ☐ Falciform
- ☐ Round (ligamentum teres)
- ☐ Right triangular
- ☐ Left triangular
- ☐ Coronary
- ☐ Suspensory ligament of duodenum (of Treitz)

OTHER CONNECTIVE TISSUES

- ☐ Greater omentum
- ☐ Lesser omentum
- ☐ External oblique aponeurosis
- ☐ Linea alba
- ☐ Anterior sheath of rectus abdominis
- ☐ Posterior sheath of rectus abdominis
- ☐ Greater omentum
- ☐ Lesser omentum
- ☐ Transverse mesocolon
- ☐ Sigmoid mesentery
- ☐ Appendicular mesentery
- ☐ Dorsal root mesentery
- ☐ Appendices epiploicae
- ☐ Teniae coli

ORGANS

- ☐ Esophagus
- ☐ Liver
  - ☐ Left lobe
  - ☐ Right lobe
  - ☐ Caudate
  - ☐ Quadrate
- ☐ Gallbladder
  - ☐ Fundus
  - ☐ Body
  - ☐ Neck
- ☐ Pancreas
- ☐ Spleen
- ☐ Stomach
  - ☐ Fundus
  - ☐ Body
  - ☐ Cardia
  - ☐ Pylorus
  - ☐ Greater curvature
  - ☐ Lesser curvature
- ☐ Small intestine
  - ☐ Duodenum
  - ☐ Jejunum
  - ☐ Ileum
- ☐ Large intestine
  - ☐ Cecum
  - ☐ Appendix
  - ☐ Ileocecal junction
    - ☐ Ascending colon
    - ☐ Transverse colon
    - ☐ Descending colon
    - ☐ Sigmoid colon
  - ☐ Hepatic flexure
  - ☐ Splenic flexure

MUSCLES

- ☐ External abdominal oblique
- ☐ Internal abdominal oblique
- ☐ Transversus abdominis
- ☐ Rectus abdominis
- ☐ Pyramidalis
- ☐ Psoas major

BONES

- ☐ Ribs 9–11
- ☐ Xiphoid process of sternum
- ☐ Sacrum
- ☐ Iliac crest of ilium

SPACES

- ☐ Omental foramen (of Winslow)
- ☐ Omental bursa
- ☐ Peritoneal cavity

VESSELS

- ☐ Inferior epigastric artery
- ☐ Inferior epigastric vein
- ☐ Superior epigastric artery
- ☐ Superior epigastric vein
- ☐ External iliac vein
- ☐ External iliac artery

ATLAS REFERENCES

Netter: 273–299, 301–305
McMinn: 234–252
Gray's Atlas: 157–182

In most cadavers, the liver occupies a significant portion of the peritoneal cavity. The gallbladder may be difficult to see at this point, but look for its fundus.

DISSECTION TIP

The gallbladder, if not surgically removed, will become visible as the dissection proceeds.

DISSECTION STEPS

- **With a scalpel, make a horizontal incision at the lower edge of the liver, removing 3 to 4 cm (1½ inches) of liver parenchyma (Fig. 12.1).**
- **Pull the stomach downward and fully expose the gallbladder and the hepatoduodenal ligament (Figs. 12.2 and 12.3).**

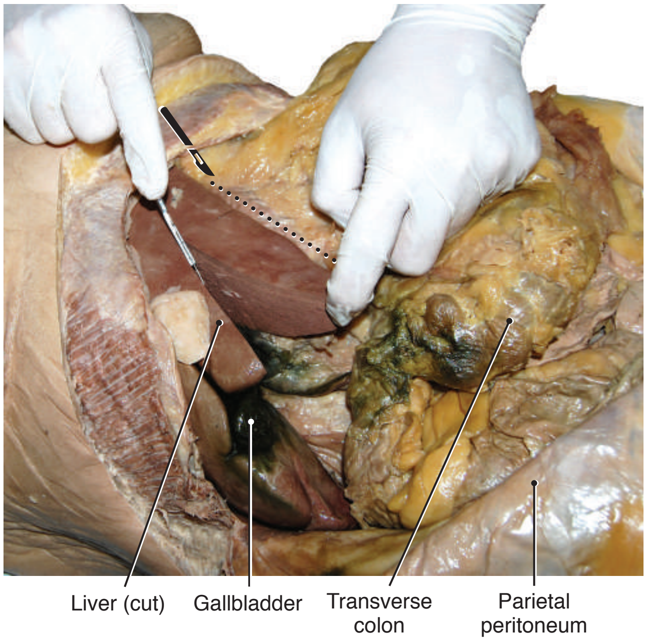
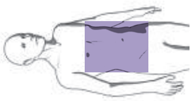


Fig. 12.1 Horizontal incision at lower edge of the liver.



DISSECTION TIP

Stripping away the hepatoduodenal ligament, you will see several nerves running along the bile duct and proper hepatic artery. These nerves are part of the autonomic nervous system and are primarily sympathetic fibers (Fig. 12.4).

- **With scissors or a probe, carefully strip away the hepatoduodenal ligament and expose the bile duct, proper hepatic artery, and hepatic portal vein (see Figs. 12.4 and 12.5).**
- **Note the relationships among these three structures: within the hepatoduodenal ligament, the portal vein**

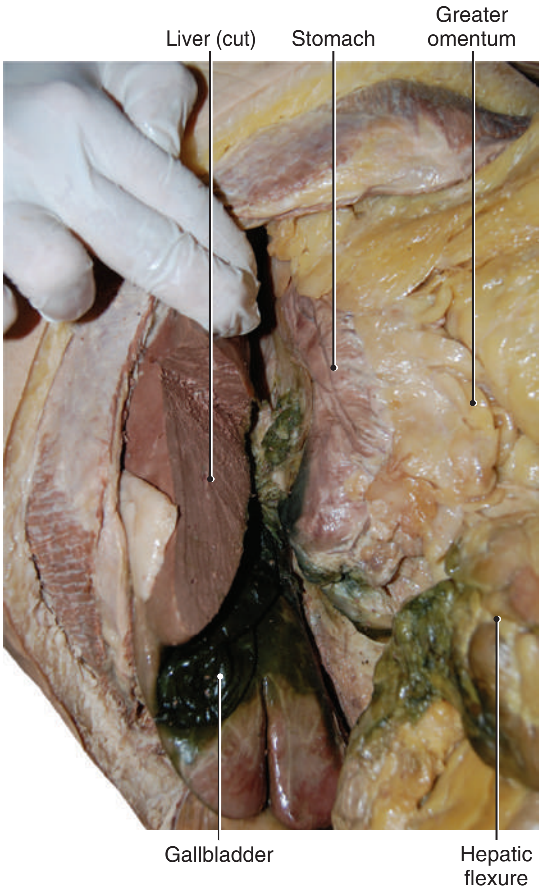


Fig. 12.2 Identify the gallbladder.

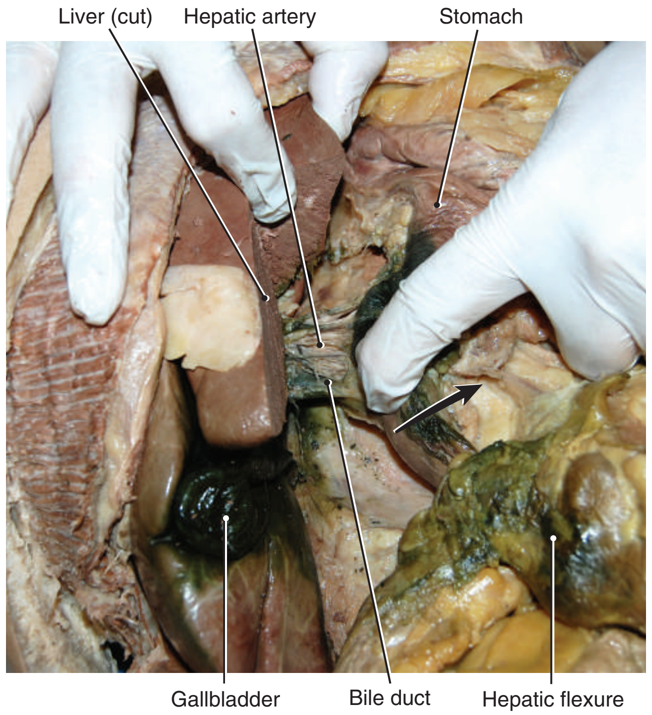
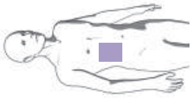

Liver (cut)
Hepatic artery
Stomach
Gallbladder
Bile duct
Hepatic flexure

Fig. 12.3 Pull the stomach downward to expose the gallbladder and hepatoduodenal ligament.



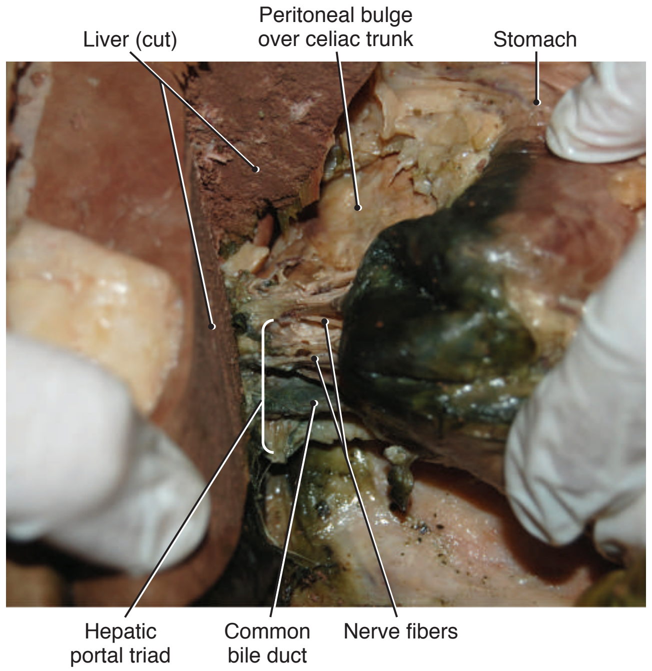
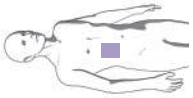

Liver (cut)
Peritoneal bulge over celiac trunk
Stomach
Hepatic portal triad
Common bile duct
Nerve fibers

Fig. 12.4 Cut the hepatoduodenal ligament to expose the bile duct, proper hepatic artery, portal vein, hepatic portal triad, and autonomic nerve fibers.



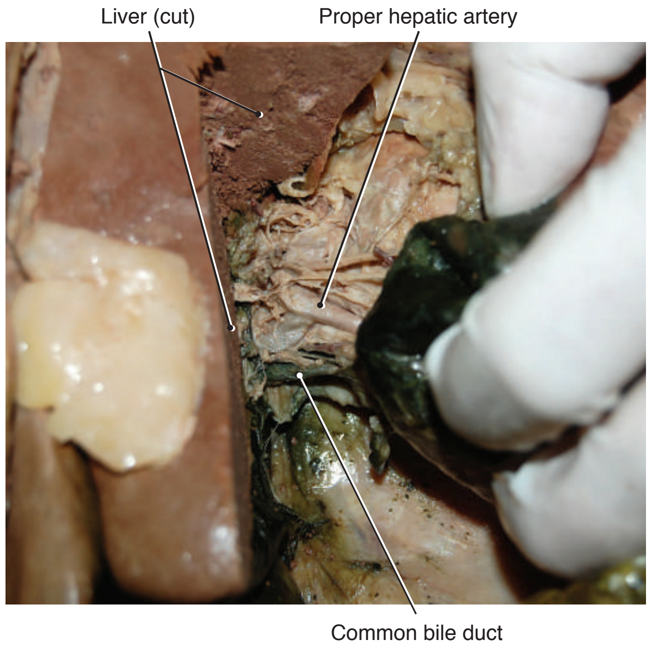
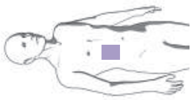

Liver (cut)
Proper hepatic artery
Common bile duct

Fig. 12.5 View shows relationship of proper hepatic artery and bile duct.



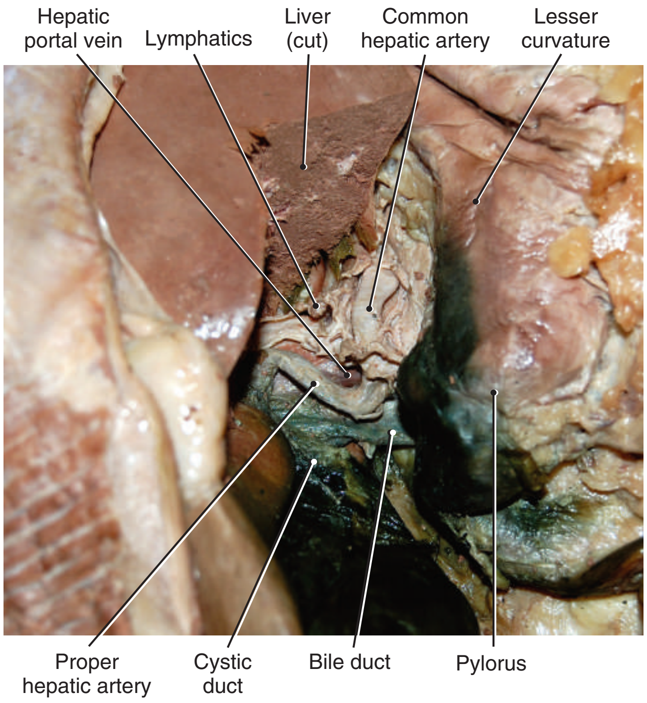
is located posteriorly, deep to the bile duct and proper hepatic artery (Fig. 12.6).

- Clean the proper hepatic artery toward the liver, and identify the right and left hepatic arteries.
- Look for the *cystic artery* supplying the gallbladder.
- The cystic artery usually arises from the right hepatic artery or the proper hepatic artery.
- Dissect out the cystic duct from the gallbladder toward its junction with the common hepatic duct to form the bile duct (Fig. 12.7).
- Once these structures are cleaned and identified, observe the *hepatocystic triangle* formed by the common hepatic duct, the cystic duct, and the liver.
- In most cases, the cystic artery is identified within this triangular region (Plate 12.1).

DISSECTION TIP

In about 65% of cases, the cystic artery arises from the right hepatic artery. If you are not able to identify the cystic artery in its typical location, lift the cystic duct and look inferior to it.

- To expose the celiac trunk and its branches, with blunt dissection, release the transverse and the descending colon from the gastrocolic ligament (Figs. 12.8 and 12.9).
- With scissors, cut the gastrocolic ligament at the superior border of the transverse colon and release it from the stomach (Fig. 12.10).


Hepatic portal vein
Lymphatics
Liver (cut)
Common hepatic artery
Lesser curvature
Proper hepatic artery
Cystic duct
Bile duct
Pylorus

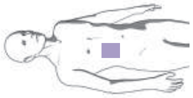
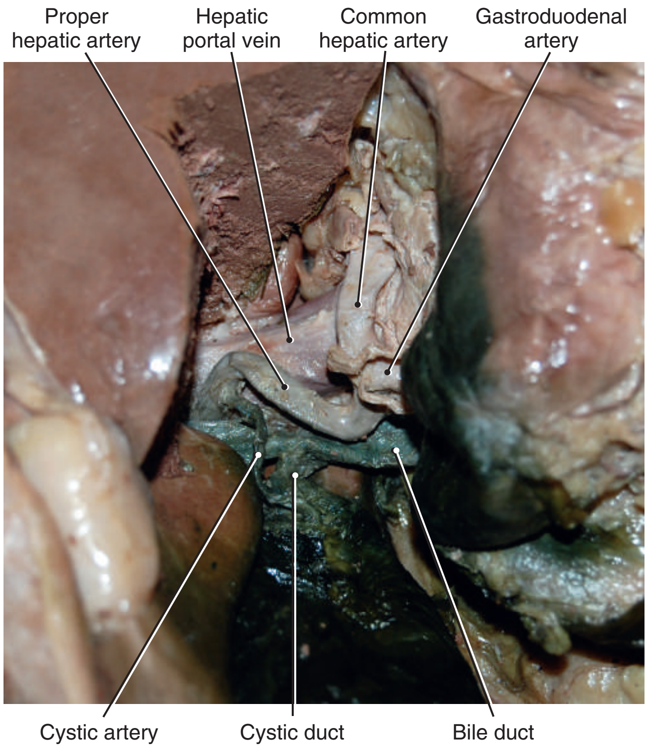


Fig. 12.6 View demonstrates relationship of proper hepatic artery, bile duct, and hepatic portal vein.


Proper hepatic artery
Hepatic portal vein
Common hepatic artery
Gastroduodenal artery
Cystic artery
Cystic duct
Bile duct

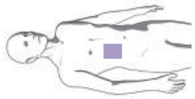


Fig. 12.7 View shows dissected cystic duct from gallbladder to junction with common hepatic duct.

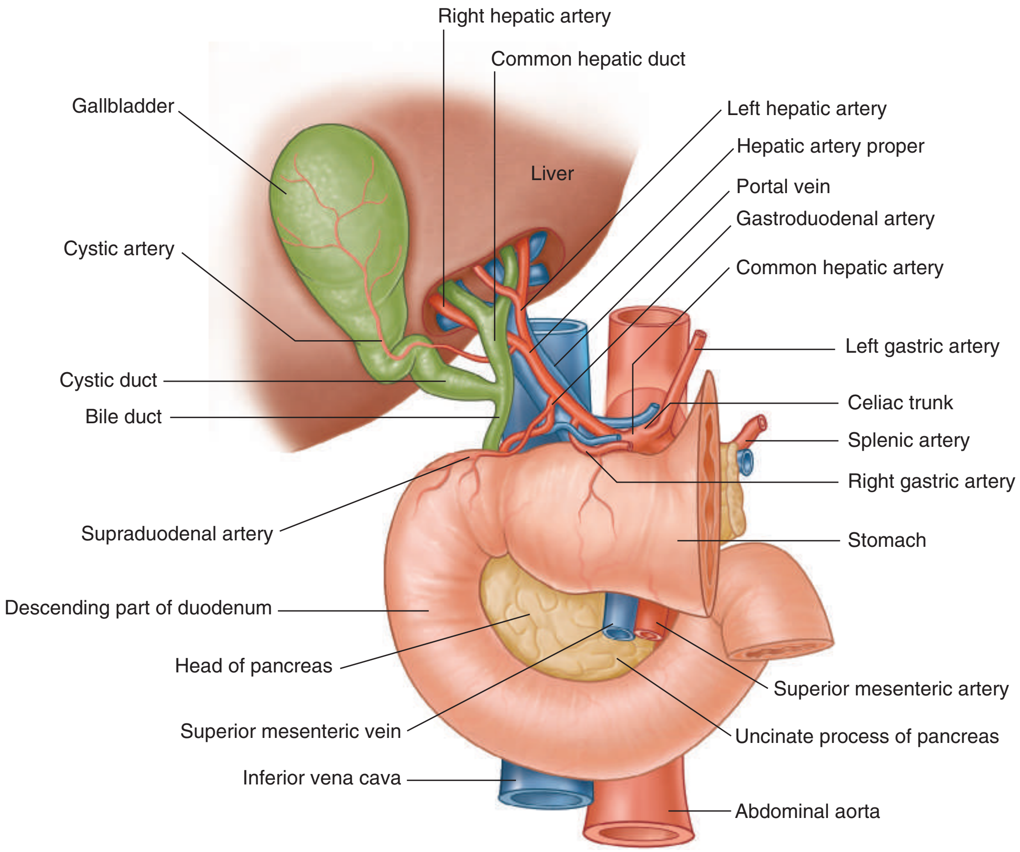

Right hepatic artery
Common hepatic duct
Gallbladder
Left hepatic artery
Hepatic artery proper
Liver
Portal vein
Gastroduodenal artery
Cystic artery
Common hepatic artery
Left gastric artery
Cystic duct
Celiac trunk
Bile duct
Splenic artery
Right gastric artery
Supraduodenal artery
Stomach
Descending part of duodenum
Head of pancreas
Superior mesenteric artery
Superior mesenteric vein
Uncinate process of pancreas
Inferior vena cava
Abdominal aorta

Plate 12.1 Distribution of common hepatic artery.

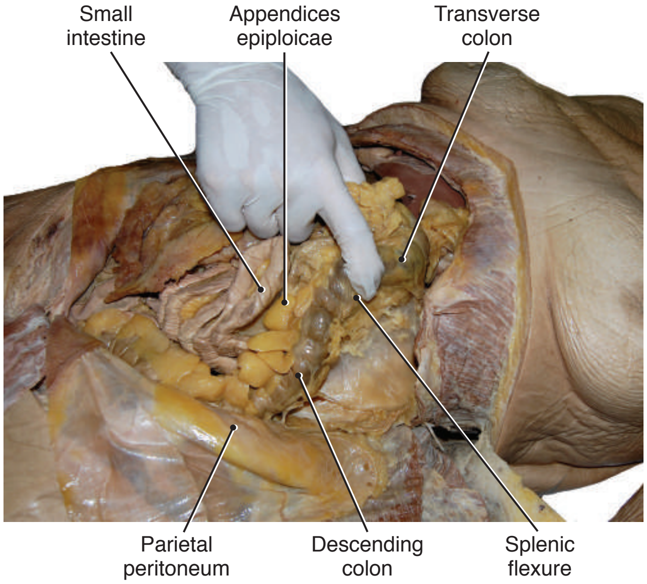
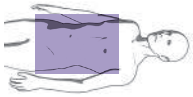

Small intestine
Appendices epiploicae
Transverse colon
Parietal peritoneum
Descending colon
Splenic flexure

Fig. 12.8 Identify the transverse colon and descending colon.



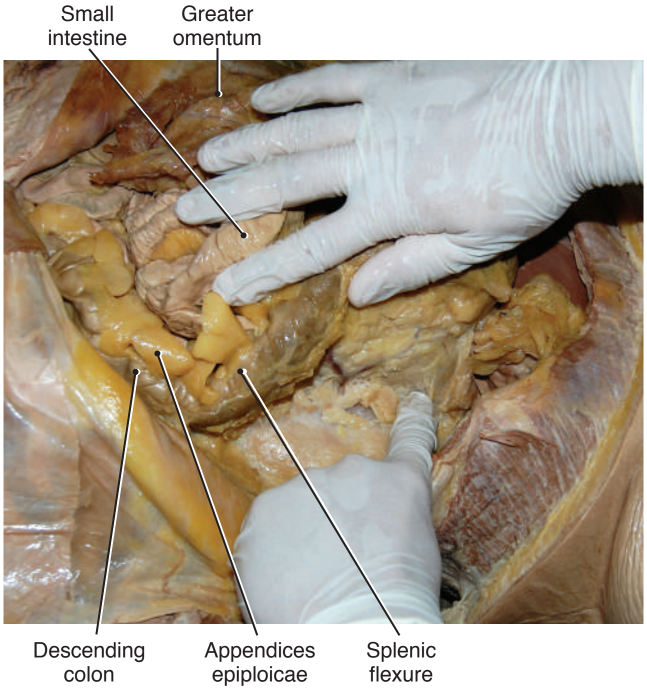
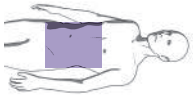

Small intestine
Greater omentum
Descending colon
Appendices epiploicae
Splenic flexure

Fig. 12.9 Blunt dissection of transverse and descending colon from the gastrocolic ligament.



- To expose the splenic artery and spleen, cut the inferior edge of the costal cartilages with a saw to expose fully the area anterior to the spleen. Place paper towels underneath the costal cartilages (Fig. 12.11).
- Identify the inferior border of the spleen, hidden by the gastrosplenic and splenorenal ligaments and, usually, abundant fat (Fig. 12.12).

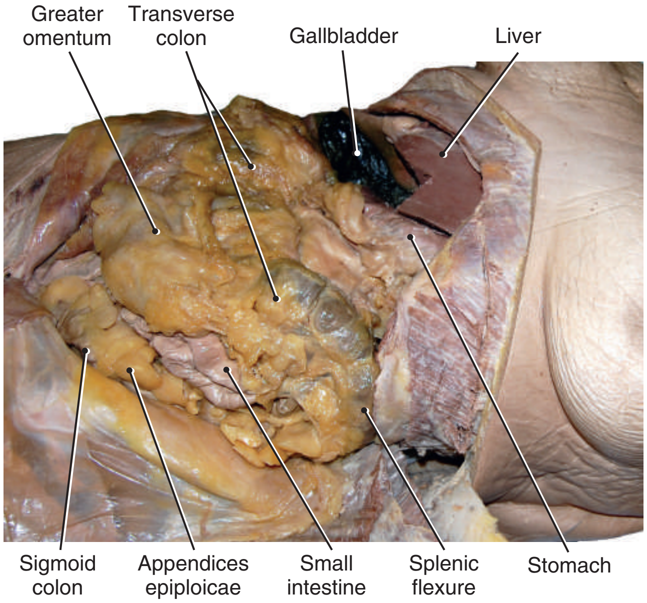
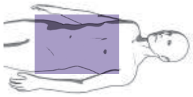

Greater omentum
Transverse colon
Gallbladder
Liver
Sigmoid colon
Appendices epiploicae
Small intestine
Splenic flexure
Stomach

Fig. 12.10 Cut the gastrocolic ligament at superior border of the transverse colon to release the colon from stomach.



DISSECTION **TIP**

The spleen rests on an abundance of adipose tissue. Once the adipose tissue is cleaned away, the spleen will drop inferiorly and posteriorly, and its vessels will be stressed and possibly broken. Place some folded paper towels posterior to the spleen to keep it at the same level as the pancreas. In addition, the paper towels will absorb any embalming fluid that accumulates in this space.

- Clean the fat and the gastrosplenic and splenorenal ligaments, and expose the splenic pedicle receiving the splenic artery and vein (Fig. 12.13).
- Continue the exposure of the splenic artery and vein and identify the splenic hilum (Fig. 12.14).
- Identify the short gastric arteries, which pass to the greater curvature of the stomach.
- Note the relationship of the spleen with the stomach and the pancreas.
- Identify the left gastroepiploic artery, which typically derives from the most inferior splenic artery hilar branch (Fig. 12.15).
- Pull the stomach upward and expose the tail of the pancreas (see Fig. 12.15).
- Continue the dissection of the splenic artery and vein from the hilum of the spleen toward the celiac trunk.
- The splenic artery is tortuous and lies hidden at the upper border of the tail and body of the pancreas (Fig. 12.16).
- Lift the stomach upward and expose the body and tail of the pancreas (Fig. 12.17).
- Clean out the splenic artery and vein from the adjacent pancreas (Fig. 12.18).

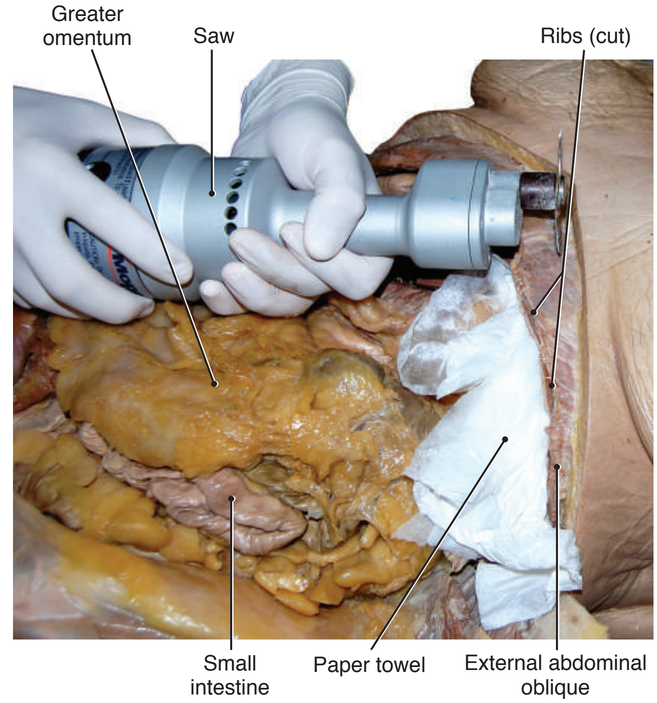
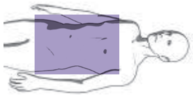

Greater omentum
Saw
Ribs (cut)
Small intestine
Paper towel
External abdominal oblique

Fig. 12.11 Saw the inferior edge of the costal cartilage.



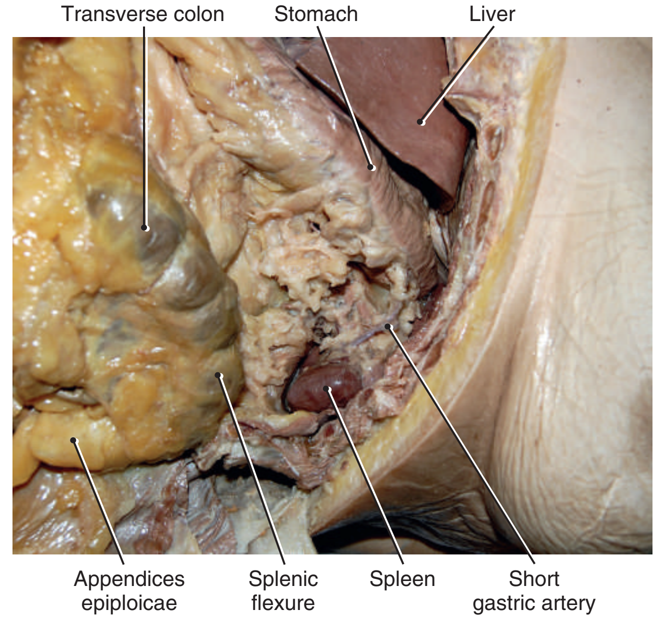
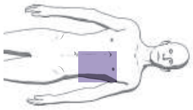

Transverse colon
Stomach
Liver
Appendices epiploicae
Splenic flexure
Spleen
Short gastric artery

Fig. 12.13 Clean fat to expose the splenic pedicle.



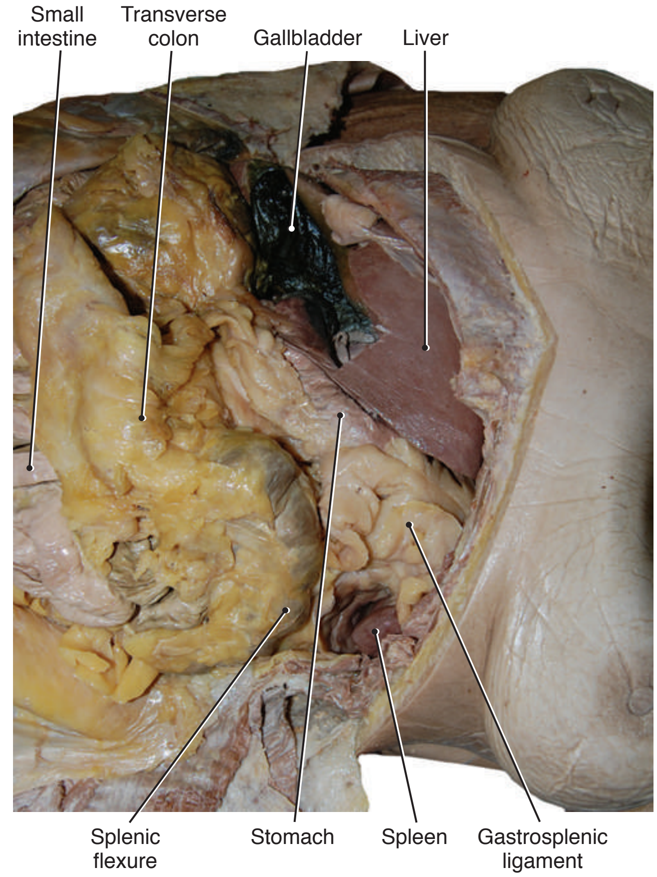
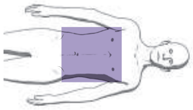

Small intestine
Transverse colon
Gallbladder
Liver
Splenic flexure
Stomach
Spleen
Gastrosplenic ligament

Fig. 12.12 Identify the inferior borders of the spleen.



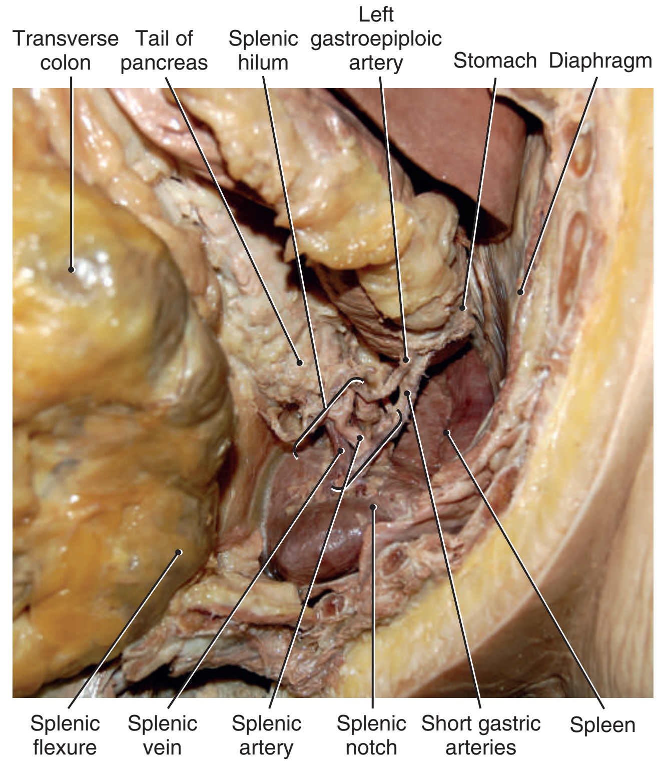
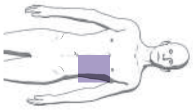

Transverse colon
Tail of pancreas
Splenic hilum
Left gastroepiploic artery
Stomach
Diaphragm
Splenic flexure
Splenic vein
Splenic artery
Splenic notch
Short gastric arteries
Spleen

Fig. 12.14 Expose the splenic artery and vein and identify the splenic hilum.



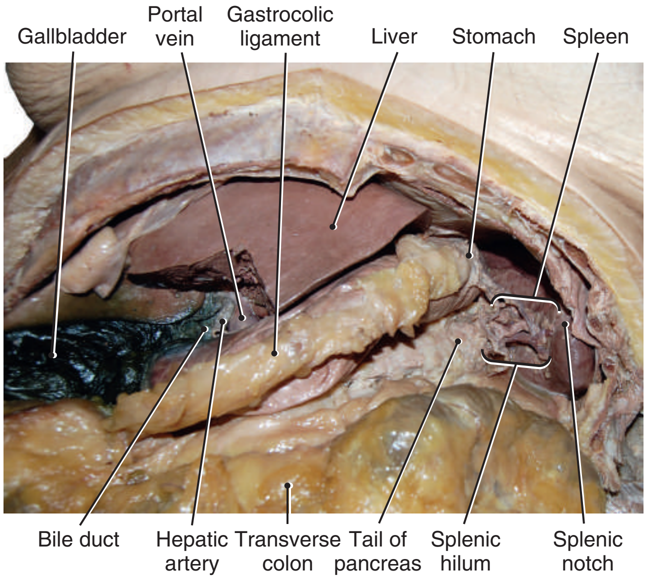
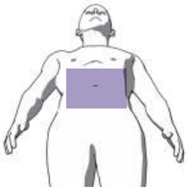

Gallbladder
Portal vein
Gastrocolic ligament
Liver
Stomach
Spleen
Bile duct
Hepatic artery
Transverse colon
Tail of pancreas
Splenic hilum
Splenic notch

Fig. 12.15 Identify the left gastroepiploic artery, and pull the stomach upward to expose tail of the pancreas.



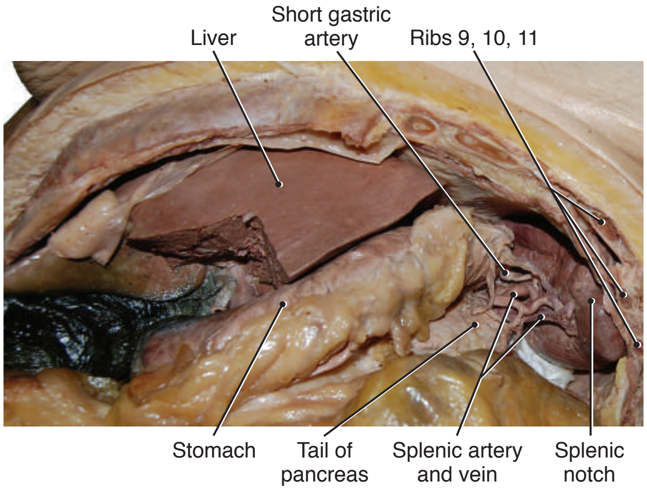
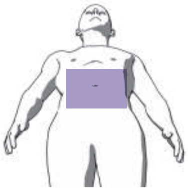

Liver
Short gastric artery
Ribs 9, 10, 11
Stomach
Tail of pancreas
Splenic artery and vein
Splenic notch

Fig. 12.16 Identify the splenic artery.



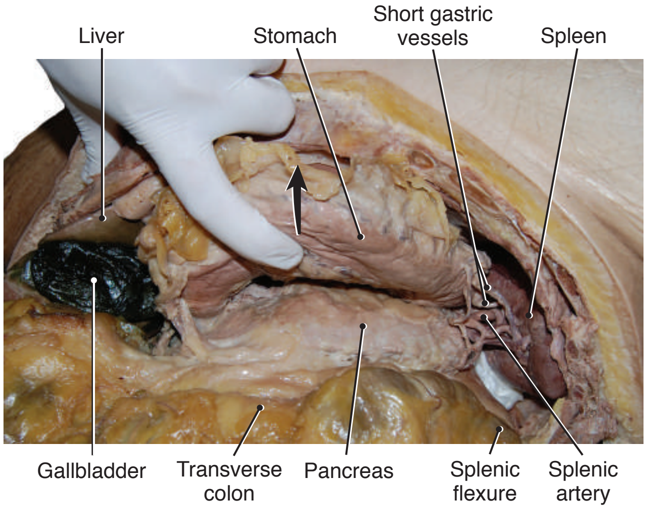
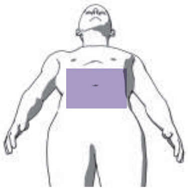

Liver
Stomach
Short gastric vessels
Spleen
Gallbladder
Transverse colon
Pancreas
Splenic flexure
Splenic artery

Fig. 12.17 Lift the stomach upward to expose the body and tail of the pancreas.



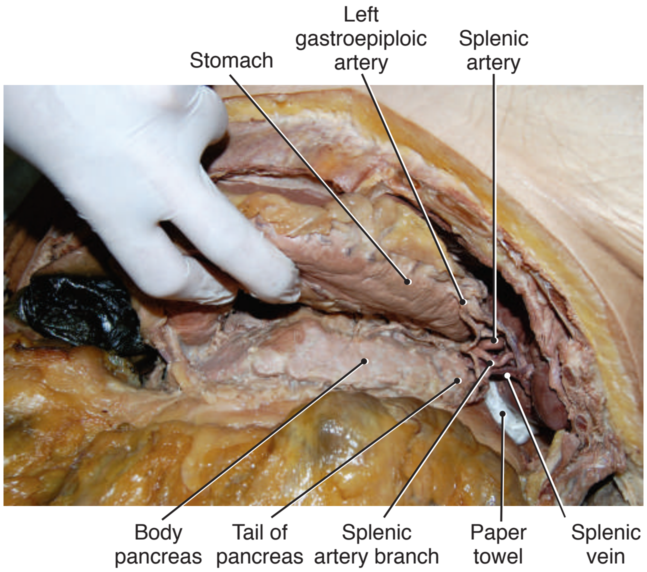
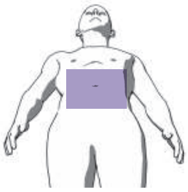

Stomach
Left gastroepiploic artery
Splenic artery
Body pancreas
Tail of pancreas
Splenic artery branch
Paper towel
Splenic vein

Fig. 12.18 Clean out splenic artery and vein from adjacent pancreas.



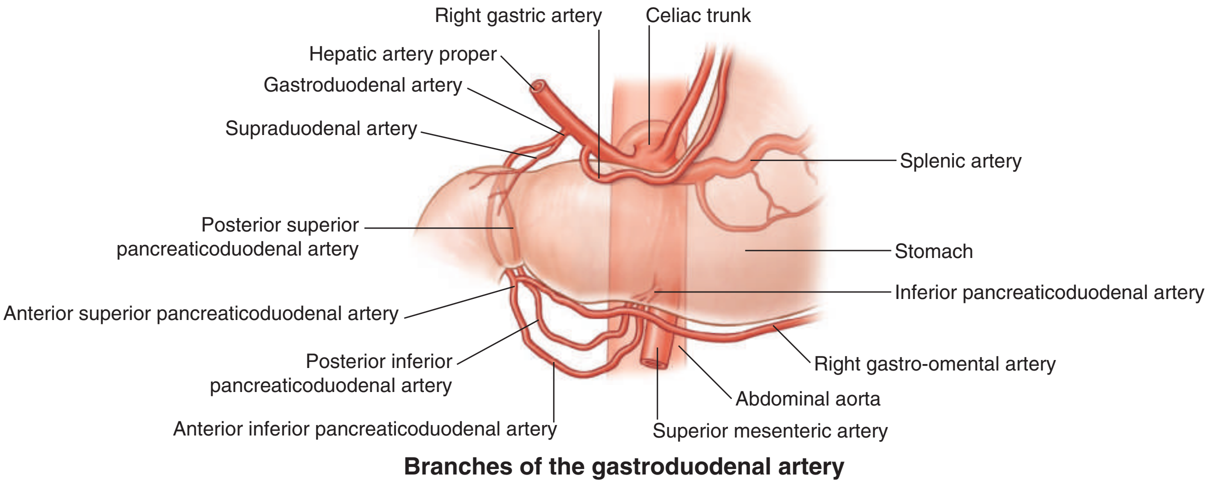

Right gastric artery
Celiac trunk
Hepatic artery proper
Gastroduodenal artery
Supraduodenal artery
Splenic artery
Posterior superior pancreaticoduodenal artery
Stomach
Inferior pancreaticoduodenal artery
Anterior superior pancreaticoduodenal artery
Right gastro-omental artery
Posterior inferior pancreaticoduodenal artery
Abdominal aorta
Anterior inferior pancreaticoduodenal artery
Superior mesenteric artery
Branches of the gastroduodenal artery

Plate 12.2 Branches of celiac trunk and gastroduodenal artery.

- Do *not* pull the splenic artery away from the pancreas, because most of its branches are short and can be injured easily.
- To visualize the area of the celiac trunk, it is necessary to lift the stomach upward and expose the pancreas. Palpate the upper border of the pancreas, and with your fingers, feel the celiac artery as a prominent bulge covered by the overlying peritoneum (Plate 12.2).

DISSECTION **TIP**

The reason for not dissecting the entire celiac trunk from the right side, at this time, is that the view from the gallbladder offers only limited exposure of the area. It is simpler to release the stomach from the gastrocolic ligament and greater omentum, identify the splenic artery at the splenic hilum, and then dissect the middle portion of the celiac trunk.

IDENTIFICATION OF DIFFERENT PARTS OF THE STOMACH

ANATOMY **NOTE**

The stomach is divided into four main regions: the cardia, fundus, body, and pylorus.

- Identify the *lesser curvature* and the *greater curvature* of the stomach.
- Identify the *angular notch*, found between the body and pyloric part of the stomach.
- Look for the cardia and the *cardiac notch* between the esophagus and fundus.

ANATOMY **NOTE**

The *fundus* is the portion of the stomach above the cardiac notch. The pylorus is divided further into the pyloric antrum and pyloric canal.

- Return to the exposed proper hepatic artery, and dissect backward toward its origin from the common hepatic artery (Figs. 12.19 and 12.20).

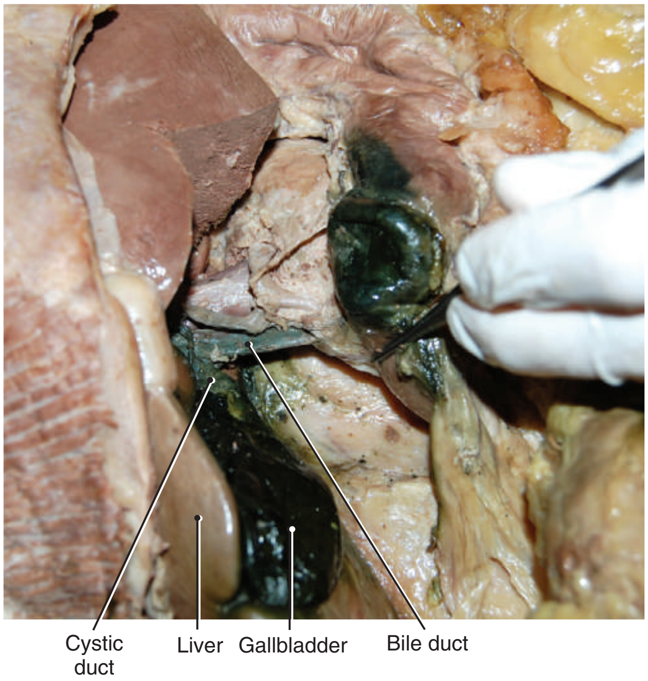
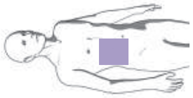

Cystic duct
Liver
Gallbladder
Bile duct

Fig. 12.19 Identify the bile duct and cystic duct.



- Identify and expose the other branch of the common hepatic artery, the gastroduodenal artery (see Fig. 12.20).
- Dissect out the right side of the lesser curvature of the stomach and identify the *right gastric artery*, a branch of the proper hepatic artery.
- Next to the right gastric artery, identify the right gastric vein and its connection to the right gastroepiploic vein via the prepyloric vein of Mayo.
- On the left side of the lesser curvature of the stomach, identify and clean the left gastric artery; then trace it back from its origin from the celiac trunk (Fig. 12.21).

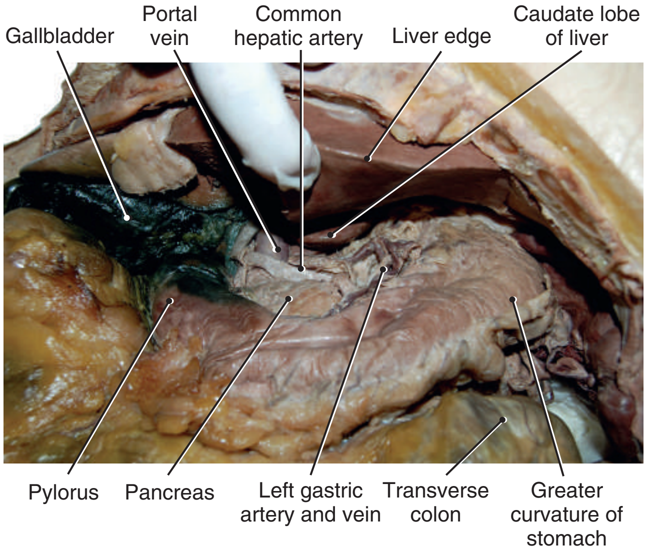
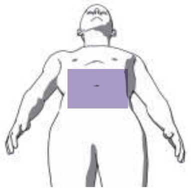

Gallbladder
Portal vein
Common hepatic artery
Liver edge
Caudate lobe of liver
Pylorus
Pancreas
Left gastric artery and vein
Transverse colon
Greater curvature of stomach

Fig. 12.20 Dissect the proper hepatic artery backward, toward its origin from the common hepatic artery.



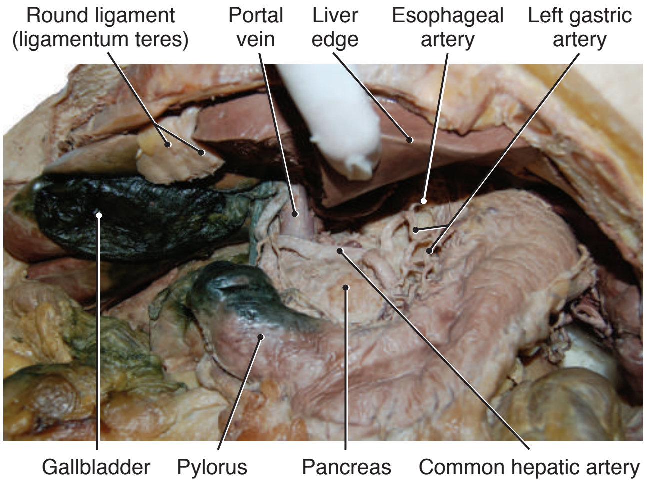
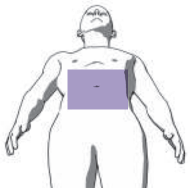

Round ligament (ligamentum teres)
Portal vein
Liver edge
Esophageal artery
Left gastric artery
Gallbladder
Pylorus
Pancreas
Common hepatic artery

Fig. 12.21 Identify and clean the left gastric artery.



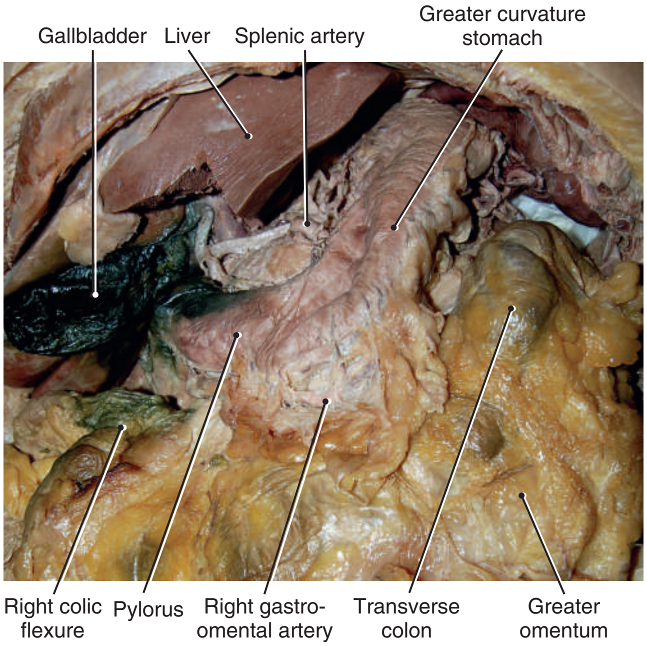
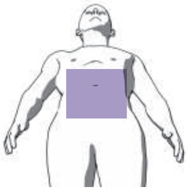

Gallbladder
Liver
Splenic artery
Greater curvature stomach
Right colic flexure
Pylorus
Right gastro-omental artery
Transverse colon
Greater omentum

Fig. 12.22 Identify the greater curvature of the stomach.



- Note the esophageal arterial branches of the left gastric artery ascending toward the esophagus.
- The left gastric artery is accompanied by the left gastric vein. Trace out any esophageal tributaries to the left gastric vein.
- In the area between the greater curvature of the stomach and the pylorus, dissect out the fat within the gastrocolic ligament and greater omentum, and identify the right gastroepiploic artery (also known as right gastro-omental artery) (Figs. 12.22 and 12.23).
- Similarly, dissect between the left side of the greater curvature of the stomach and spleen and identify the left gastroepiploic artery.
- After identifying the right and left gastroepiploic arteries, with scissors, cut along the line marking the junction between the body of the stomach and the pyloric antrum, 4 to 5 cm (~2 inches) proximal to the pylorus (Fig. 12.24).
- Retract the two parts of the transected stomach laterally and expose the celiac trunk and pancreas (Fig. 12.25).
- Lift the splenic artery from the upper border of the pancreas and dissect it out (Fig. 12.26).
- Once the splenic artery is fully exposed, notice its tortuosity (Fig. 12.27).
- Place the left side of the stomach in such a position that you can visualize all the branches of the celiac trunk and identify the origins and distributions of these branches (Figs. 12.28 and 12.29).

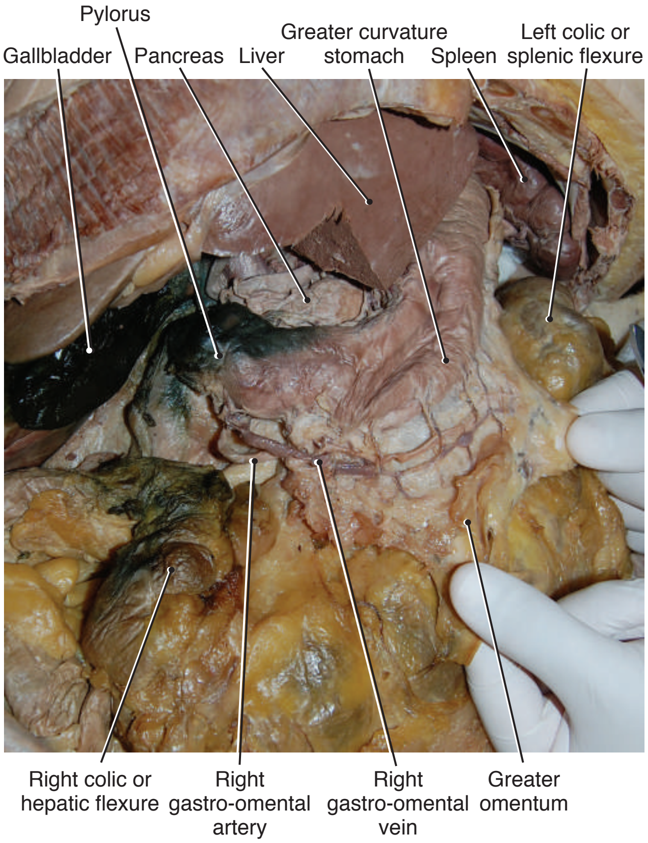
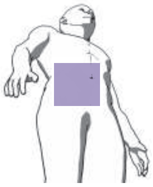

Pylorus
Gallbladder
Pancreas
Liver
Greater curvature stomach
Spleen
Left colic or splenic flexure
Right colic or hepatic flexure
Right gastro-omental artery
Right gastro-omental vein
Greater omentum

Fig. 12.23 Dissect out the fat within the gastrocolic ligament and greater omentum and identify the right gastroepiploic artery.



DISSECTION **TIP**

Note the following common arterial variations of the celiac trunk:

- Celiac artery and superior mesenteric artery arising as a common trunk (celiomesenteric trunk, 2.5% of cases)
- Proper hepatic and superior mesenteric arteries arising as a common trunk (hepatomesenteric trunk)
- Splenic artery and left gastric artery arising as a common trunk (lienogastric [splenogastric] trunk, 5.5%)
- Left gastric and common hepatic artery arising as a common trunk (gastrohepatic or hepatogastric trunk, 1.5%)
- Left gastric artery arising from the left hepatic artery (25%)
- Right hepatic artery arising from the superior mesenteric artery (18%)
- Cystic artery arising from proper hepatic or left hepatic artery
- Aberrant left hepatic artery arising from the left hepatic artery (25%)

ANATOMY **NOTE**

The pancreas typically is subdivided into the following parts: head, neck, body, and tail. The head is encircled by the first three parts of the duodenum and contains the *uncinate process*, which is located posteroinferiorly to the superior mesenteric artery and vein. Its terminal part, the tail, is related to the hilum of the spleen and left.

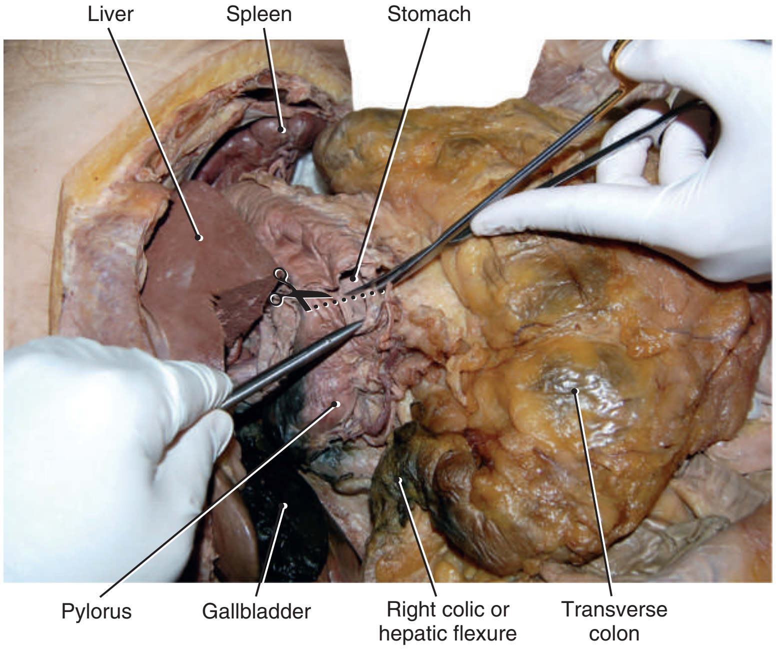
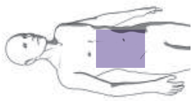

Liver
Spleen
Stomach
Pylorus
Gallbladder
Right colic or hepatic flexure
Transverse colon

Fig. 12.24 With scissors, cut along the junction between the body of the stomach and the pyloric antrum.



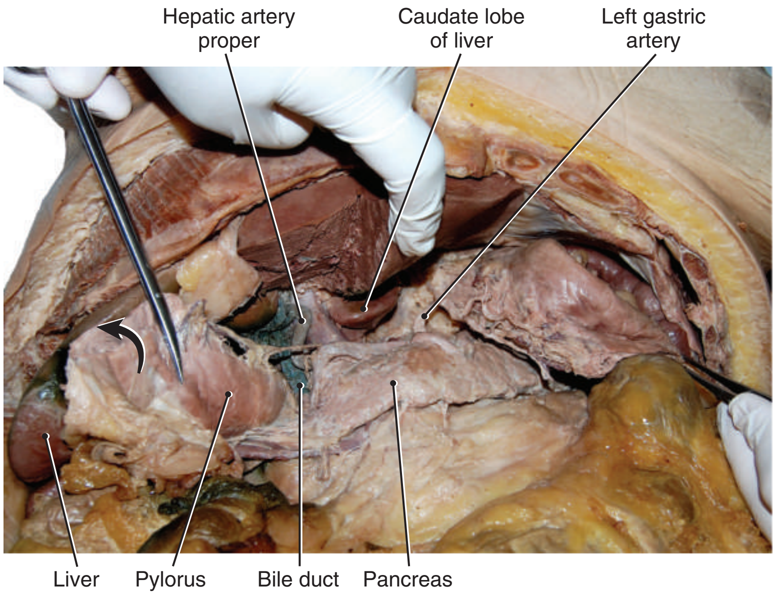
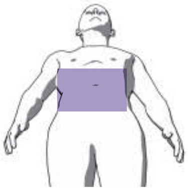

Hepatic artery proper
Caudate lobe of liver
Left gastric artery
Liver
Pylorus
Bile duct
Pancreas

Fig. 12.25 Expose the celiac trunk and pancreas.



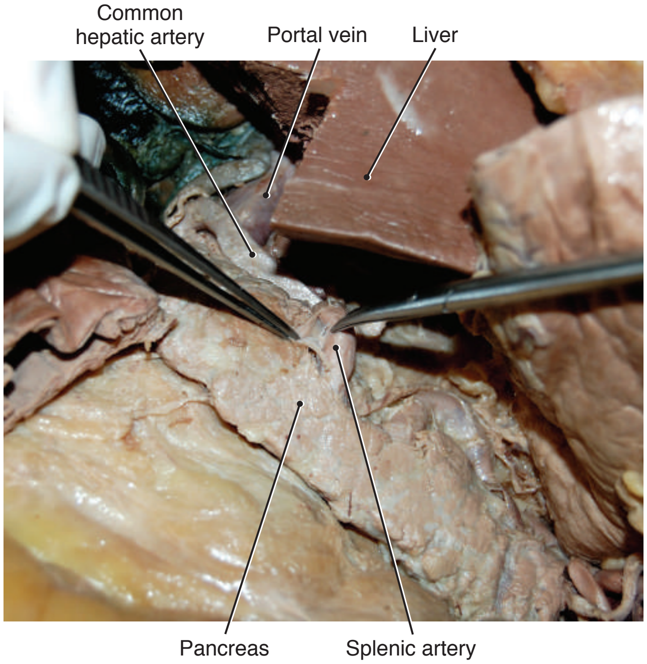
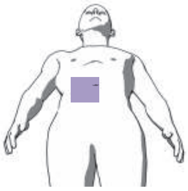

Common hepatic artery
Portal vein
Liver
Pancreas
Splenic artery

Fig. 12.26 Dissect the splenic artery from the upper border of the pancreas.



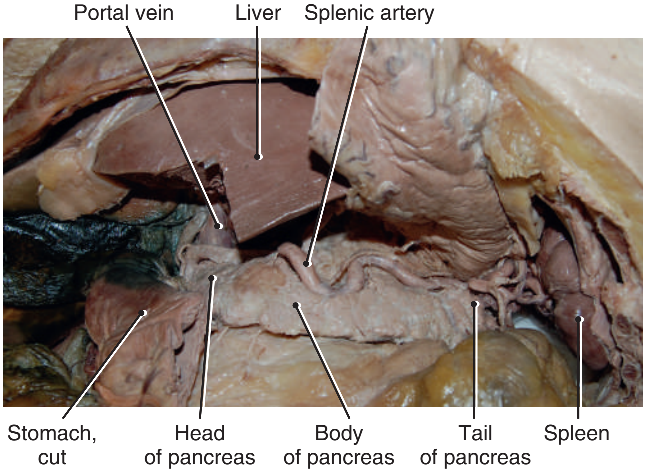
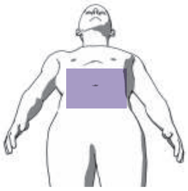

Portal vein
Liver
Splenic artery
Stomach, cut
Head of pancreas
Body of pancreas
Tail of pancreas
Spleen

Fig. 12.27 Note the tortuous route of the splenic artery.



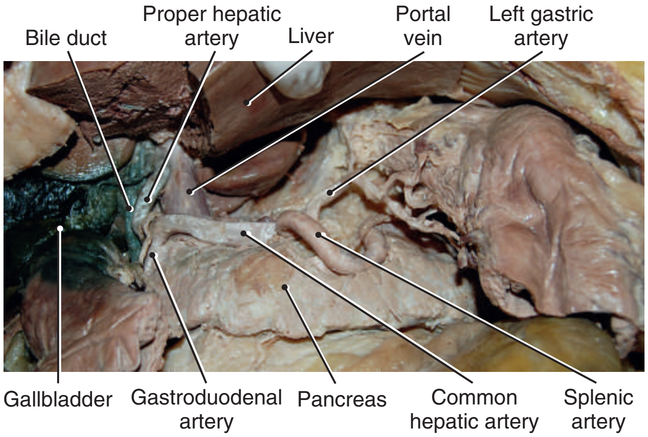
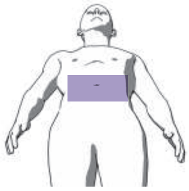

Bile duct
Proper hepatic artery
Liver
Portal vein
Left gastric artery
Gallbladder
Gastroduodenal artery
Pancreas
Common hepatic artery
Splenic artery

Fig. 12.28 Displace the stomach to visualize the branches of the celiac trunk.



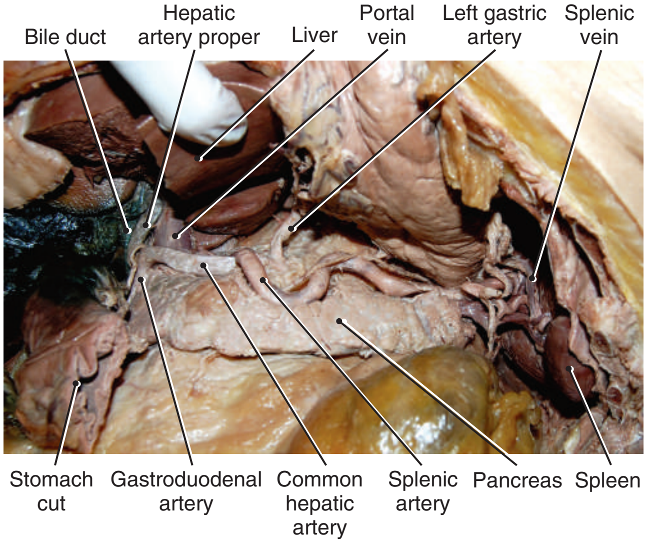
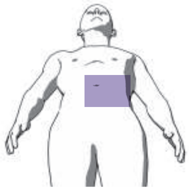

Bile duct
Hepatic artery proper
Liver
Portal vein
Left gastric artery
Splenic vein
Stomach cut
Gastroduodenal artery
Common hepatic artery
Splenic artery
Pancreas
Spleen

Fig. 12.29 Identify the origins and distributions of the branches of the celiac artery.



- On the right side of the cadaver, dissect out the branches of the gastroduodenal artery anteriorly.
- Around the head of the pancreas, look for the origin of the two terminal branches of the gastroduodenal artery, the right gastroepiploic and superior pancreaticoduodenal arteries (Fig. 12.30).
- The right gastroepiploic artery is typically found around the right side of the greater curvature of the stomach. Identify it.
- The superior pancreaticoduodenal artery divides into the posterior superior and anterior superior pancreaticoduodenal arteries supplying the head of the pancreas (see Fig. 12.30). Identify it.

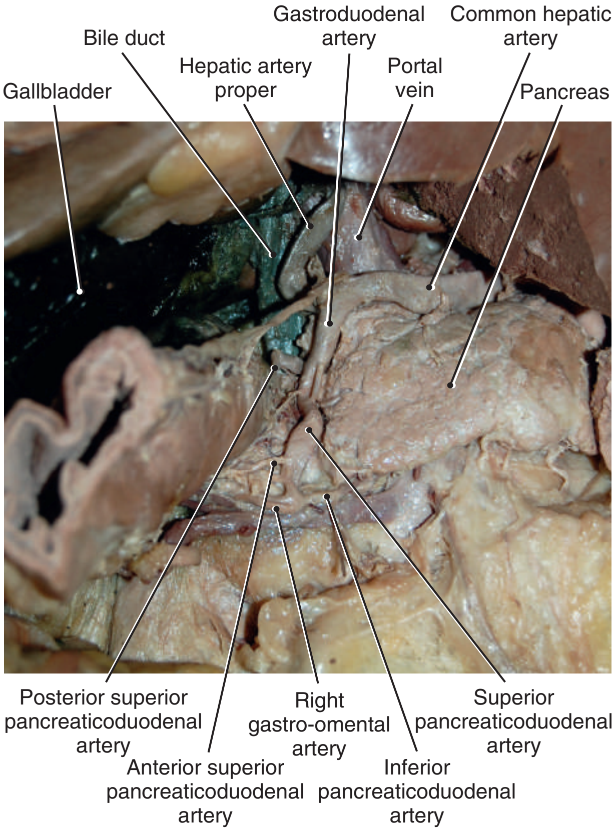
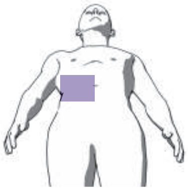

Bile duct
Gastroduodenal artery
Common hepatic artery
Gallbladder
Hepatic artery proper
Portal vein
Pancreas
Posterior superior pancreaticoduodenal artery
Right gastro-omental artery
Superior pancreaticoduodenal artery
Anterior superior pancreaticoduodenal artery
Inferior pancreaticoduodenal artery

Fig. 12.30 Identify the origin of the two terminal branches of the gastroduodenal artery, the right gastroepiploic artery and superior pancreaticoduodenal artery.



DISSECTION **TIP**

To expose the arterial branches, as well as the course of the bile duct down to the duodenum, reflect the stomach and duodenum to the left. Use your fingers to dissect the area underneath the duodenum and inferior vena cava; this is an avascular plane that is easily reflected to the left. This is called the *Kocher maneuver,* or "kocherizing" (Fig. 12.31).

DISSECTION **TIP**

A good way to trace and expose the posterior superior pancreaticoduodenal (PSPD) artery is to dissect out the bile duct from the lateral side (see Fig. 12.31). The artery that crosses over the bile duct is the PSPD. Furthermore, this artery passes behind the head of the pancreas and the 2nd part of the duodenum.

- Follow the gastroduodenal artery posteriorly toward the 1st part of the duodenum and expose the origin of the PSPD artery (Figs. 12.32 and 12.33).
- Trace the course of the anterior superior pancreaticoduodenal artery (see Figs. 12.33 and 12.34), and expose its anastomosis with the inferior pancreaticoduodenal artery, a branch of the superior mesenteric artery.

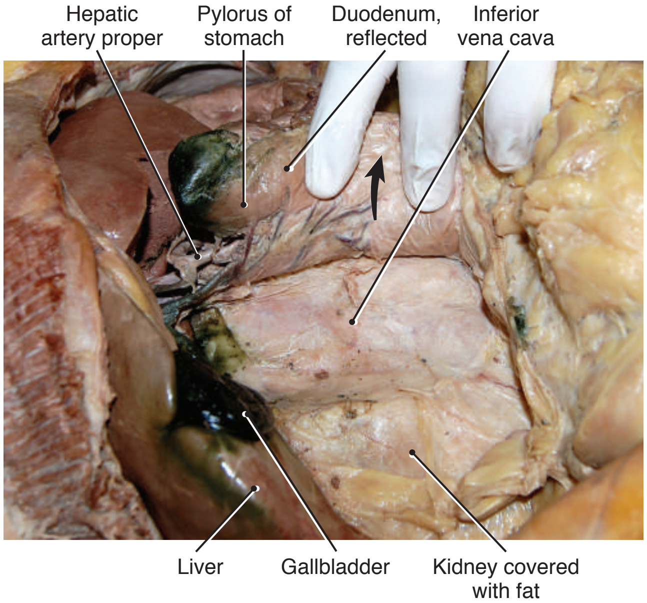
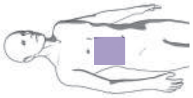

Hepatic artery proper
Pylorus of stomach
Duodenum, reflected
Inferior vena cava
Liver
Gallbladder
Kidney covered with fat

Fig. 12.31 Reflect the stomach and duodenum to the left, and bluntly dissect the area underneath the duodenum and inferior vena cava using the Kocher maneuver.



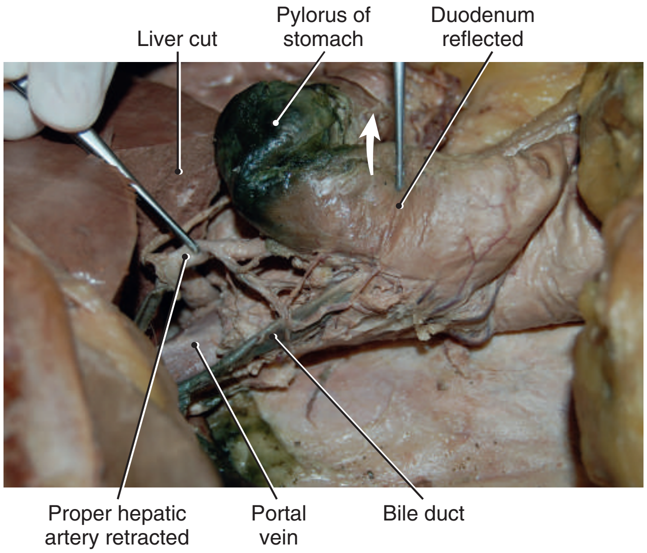
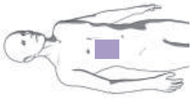

Liver cut
Pylorus of stomach
Duodenum reflected
Proper hepatic artery retracted
Portal vein
Bile duct

Fig. 12.32 Follow the gastroduodenal artery posteriorly toward the 1st part of the duodenum, and expose the origin of the posterior superior pancreaticoduodenal artery.



OPTIONAL DISSECTION OF BRANCHES OF SPLENIC ARTERY

○ **Lift the splenic artery up and look for the origin of several branches. The following landmarks help identify these branches:**

1. Lift the pancreas and look for the point where the portal vein crosses the pancreas posteriorly (neck of the pancreas). At this point, look for a branch from the splenic artery, the *dorsal pancreatic artery.*

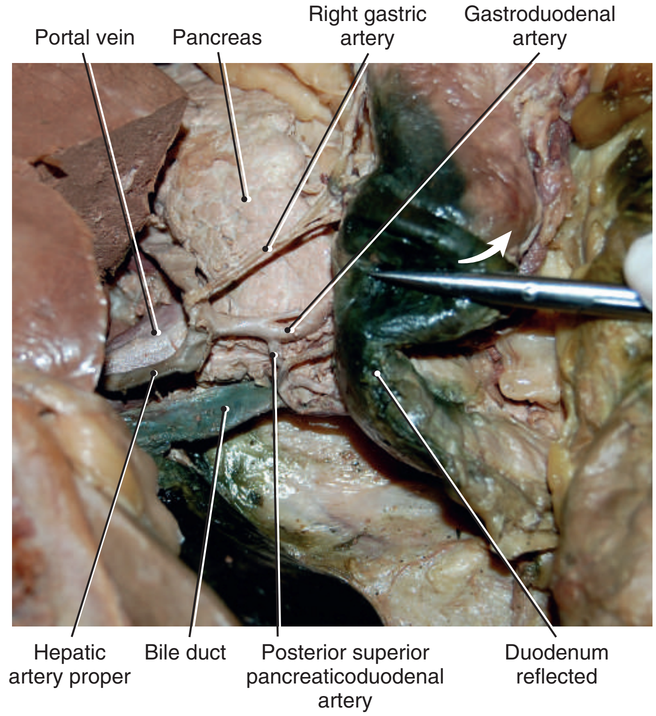
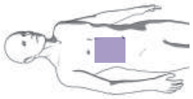

Portal vein
Pancreas
Right gastric artery
Gastroduodenal artery
Hepatic artery proper
Bile duct
Posterior superior pancreaticoduodenal artery
Duodenum reflected

Fig. 12.33 Trace the course of the anterior superior pancreaticoduodenal artery.



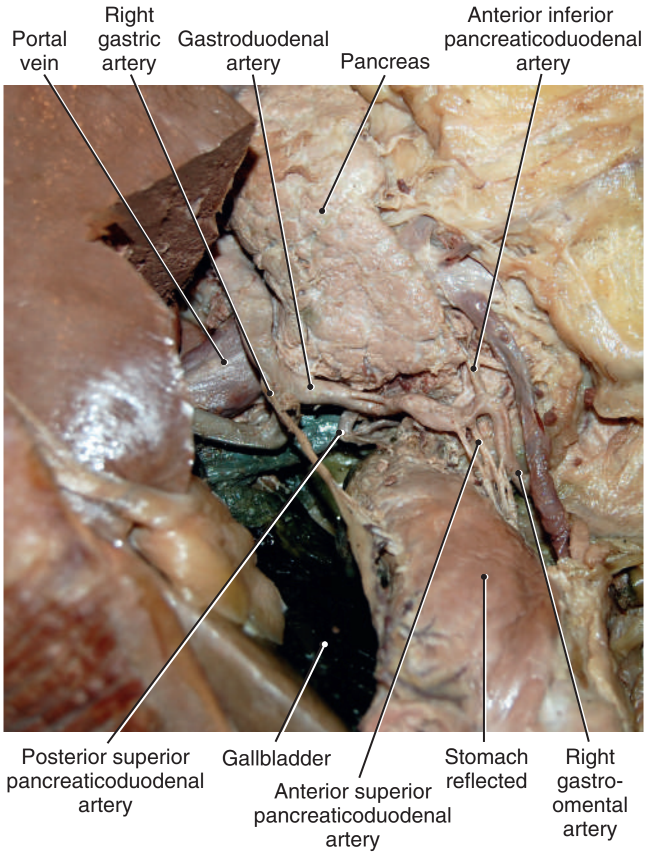
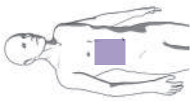

Portal vein
Right gastric artery
Gastroduodenal artery
Pancreas
Anterior inferior pancreaticoduodenal artery
Posterior superior pancreaticoduodenal artery
Gallbladder
Anterior superior pancreaticoduodenal artery
Stomach reflected
Right gastro-omental artery

Fig. 12.34 Expose the anterior superior pancreaticoduodenal artery's anastomosis with the inferior pancreaticoduodenal artery.



2. The splenic artery often gives off small branches at the superior border of the body and the tail of the pancreas, the *short pancreatic branches.*
3. The largest of these short pancreatic branches is the *great pancreatic artery*, which often is found at the distal one-third of the pancreas near its tail.
4. At the same point of the great pancreatic artery, look for a branch of the splenic artery traveling to the posterior part of the stomach supplying the gastric fundus, the *posterior gastric artery.*
5. Look 1 to 2 cm superior to the inferior border of the pancreas; embedded in its substance is the *transverse pancreatic artery.*

- **Make a horizontal incision at the pyloric antrum, pylorus, and duodenum and observe the inner surface of these structures (Fig. 12.35).**
- **Appreciate the gastric folds at the inner surface of the pyloric antrum and the circular muscle of the pyloric sphincter (Fig. 12.36).**
- **Continue the incision at the 1st, 2nd, and 3rd parts of the duodenum, and note the circular folds of Kerckring (Figs. 12.37 and 12.38).**
- **Cut the gastroduodenal artery and expose the course of the bile duct toward the duodenum (Fig. 12.39).**

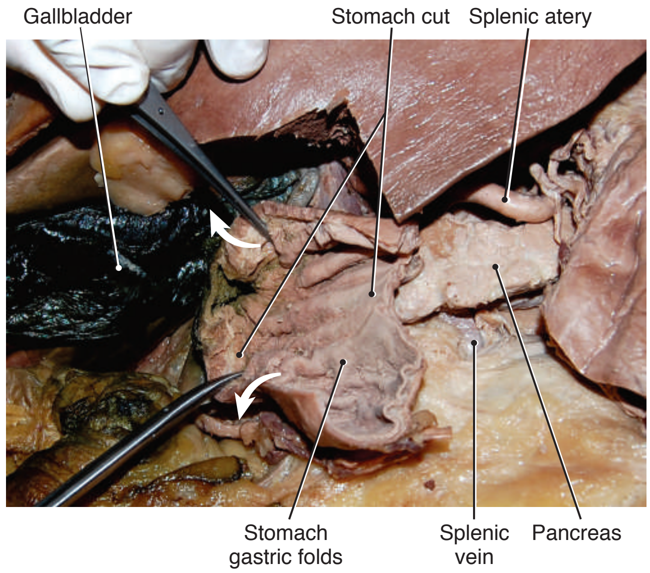
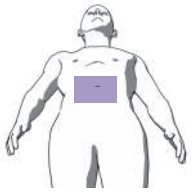

Gallbladder
Stomach cut
Splenic atery
Stomach gastric folds
Splenic vein
Pancreas

Fig. 12.36 Note gastric rugae at the inner surface of the pyloric antrum and circular muscle of the pyloric sphincter.



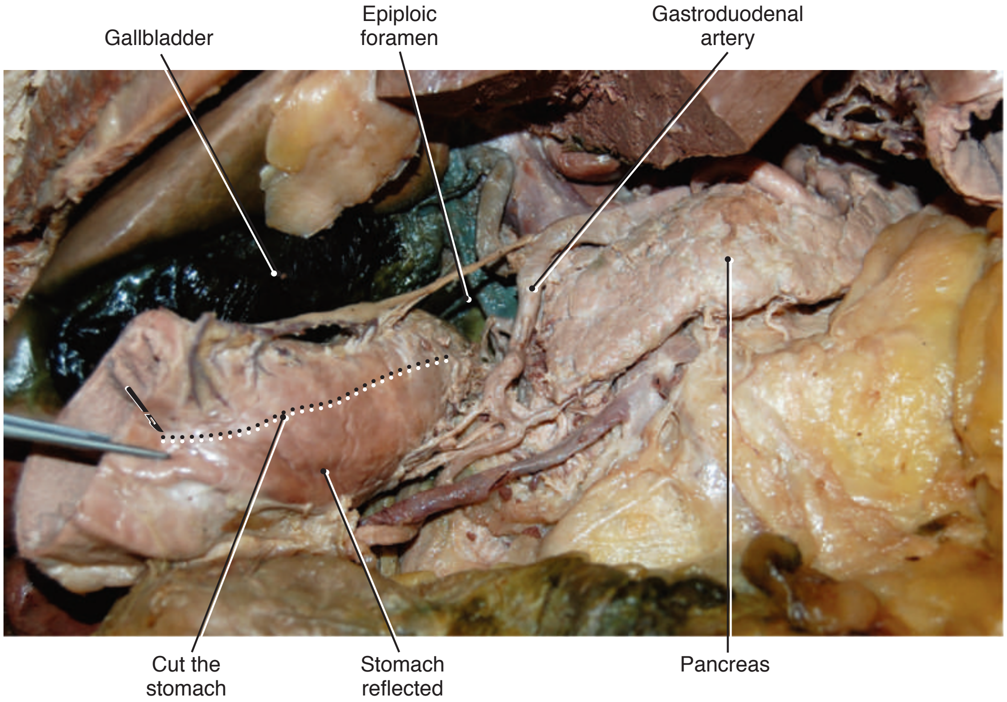
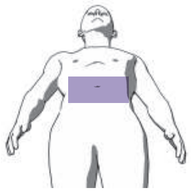

Gallbladder
Epiploic foramen
Gastroduodenal artery
Cut the stomach
Stomach reflected
Pancreas

Fig. 12.35 Make a horizontal cut at the pyloric antrum, pylorus, and duodenum.



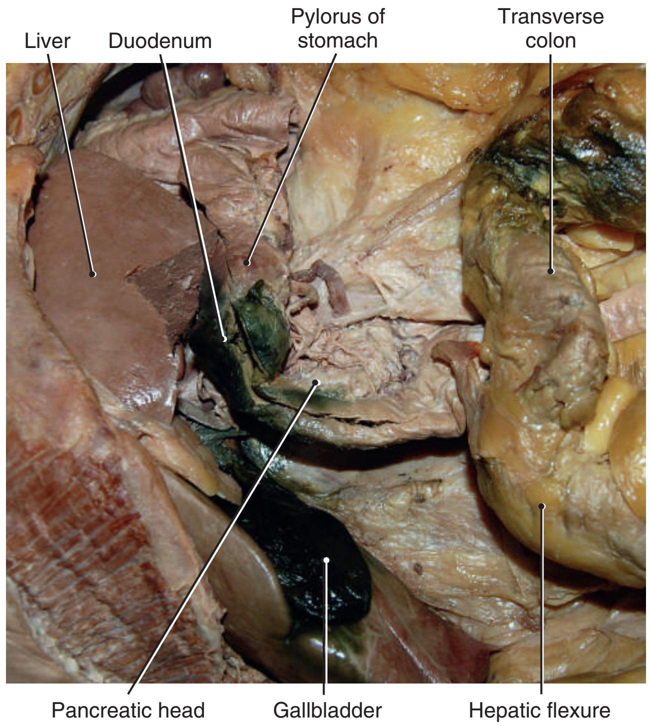
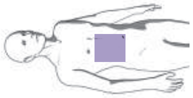

Liver
Duodenum
Pylorus of stomach
Transverse colon
Pancreatic head
Gallbladder
Hepatic flexure

Fig. 12.37 Continue an incision through the 1st, 2nd, and 3rd parts of duodenum.



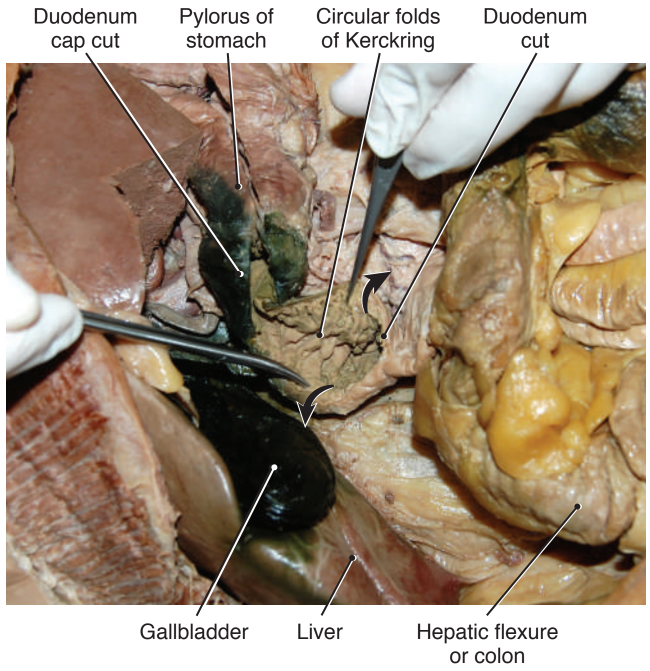
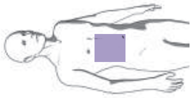

Duodenum cap cut
Pylorus of stomach
Circular folds of Kerckring
Duodenum cut
Gallbladder
Liver
Hepatic flexure or colon

Fig. 12.38 Note the circular folds of Kerckring.



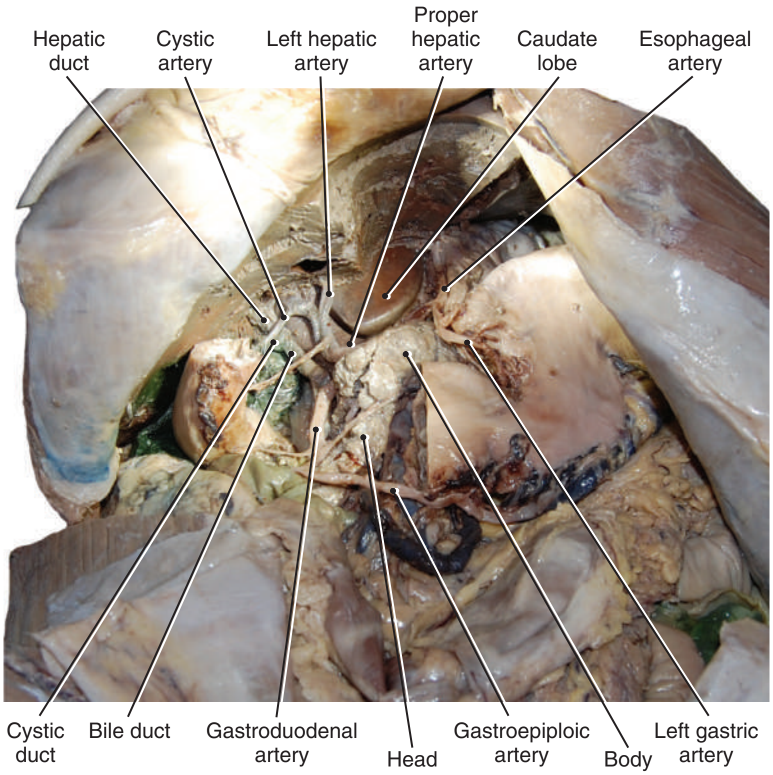
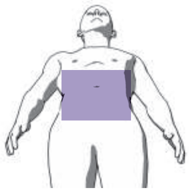

Hepatic duct
Cystic artery
Left hepatic artery
Proper hepatic artery
Caudate lobe
Esophageal artery
Cystic duct
Bile duct
Gastroduodenal artery
Head
Gastroepiploic artery
Body
Left gastric artery

Fig. 12.39 Cut the gastroduodenal artery and expose the course of the bile duct.



ANATOMY **NOTE**

The bile duct is divided into supraduodenal (above duodenum), retroduodenal (behind duodenum), and pancreatic parts (terminal part) (Fig. 12.40).

- Open up the descending part of the duodenum and identify the intraduodenal portion of the bile duct; find its connection with the main pancreatic duct (of Wirsung), forming the hepatopancreatic ampulla (of Vater).
- Identify the duodenal papilla, which contains the hepatopancreatic ampulla.
- Expose the main pancreatic duct into the substance of the pancreas by removing pancreatic tissue with your forceps (see Fig. 12.40).
- Look for an accessory pancreatic duct (of Santorini), if present.
- With your forceps, lift the pancreas and identify the *splenic vein* (Fig. 12.41).
- Expose the splenic vein along its entire length, and trace out its junction with the superior mesenteric vein to form the *portal vein* (Figs. 12.42 and 12.43).
- Next to the superior mesenteric vein, look for the inferior mesenteric vein, usually draining into the splenic vein (Plate 12.3).
- Continue exposing the tributaries of the superior mesenteric vein.
- Next to its tributaries, expose the arterial branches of the *superior mesenteric artery* (Fig. 12.44).

DISSECTION **TIP**

The vast majority of tissue that must be removed to expose the branches of the superior mesenteric artery and vein is fat and dense autonomic nerve tissue.

- Lift the transverse colon and observe the transverse *mesocolon* (Fig. 12.45).
- With your fingertips, penetrate the transverse mesocolon and expose the underlying superior mesenteric artery and vein (Fig. 12.46).

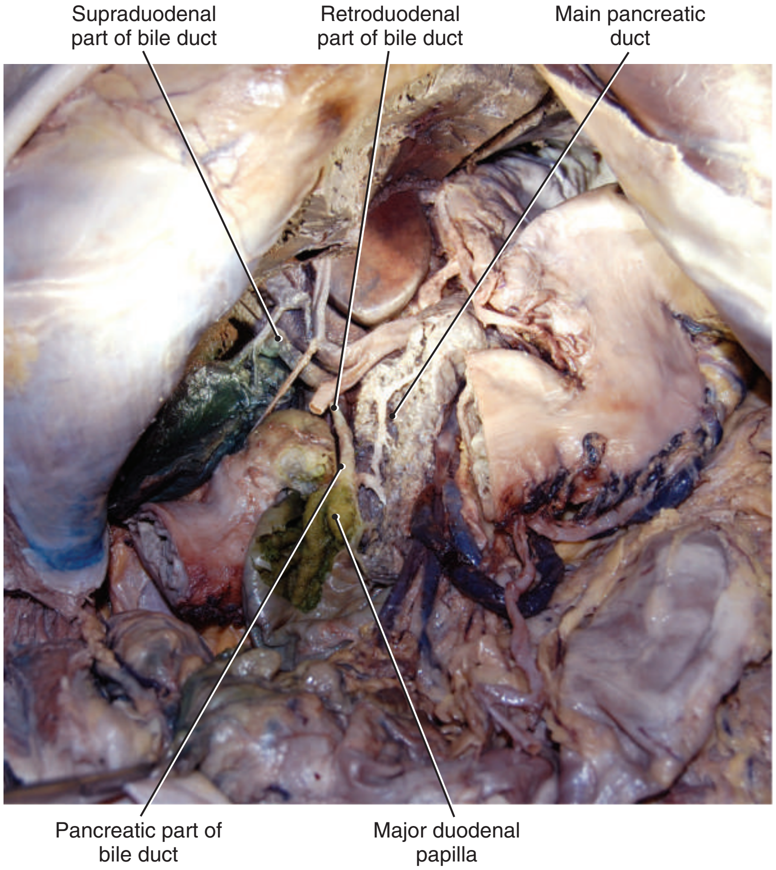
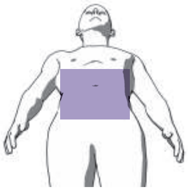

Supraduodenal part of bile duct
Retroduodenal part of bile duct
Main pancreatic duct
Pancreatic part of bile duct
Major duodenal papilla

Fig. 12.40 Note divisions of the bile duct: supraduodenal, retroduodenal, and pancreatic parts.



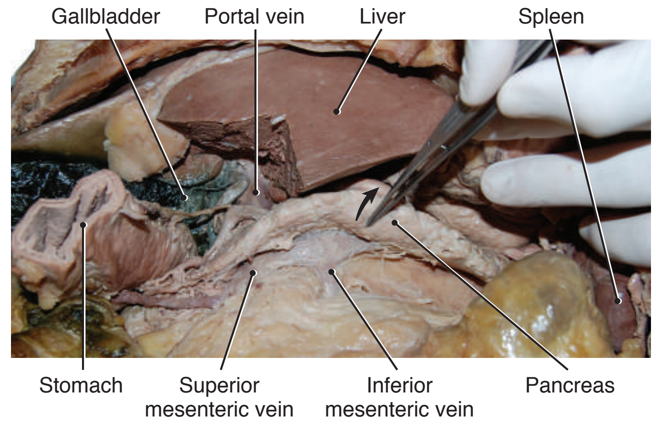
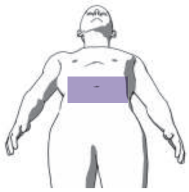

Gallbladder
Portal vein
Liver
Spleen
Stomach
Superior mesenteric vein
Inferior mesenteric vein
Pancreas

Fig. 12.41 With forceps, lift the pancreas and identify the splenic vein.



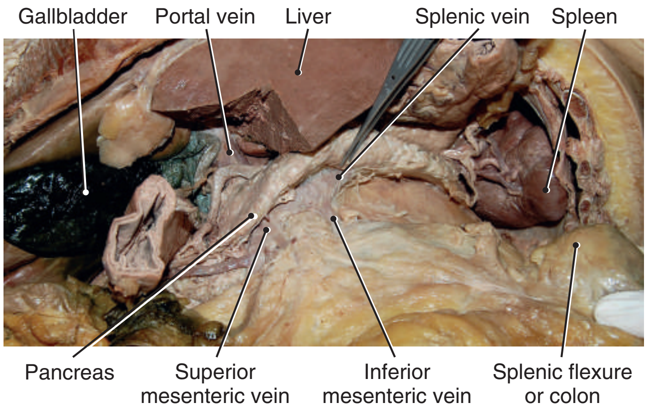
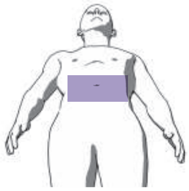

Gallbladder
Portal vein
Liver
Splenic vein
Spleen
Pancreas
Superior mesenteric vein
Inferior mesenteric vein
Splenic flexure or colon

Fig. 12.42 Expose the splenic vein along its entire length.



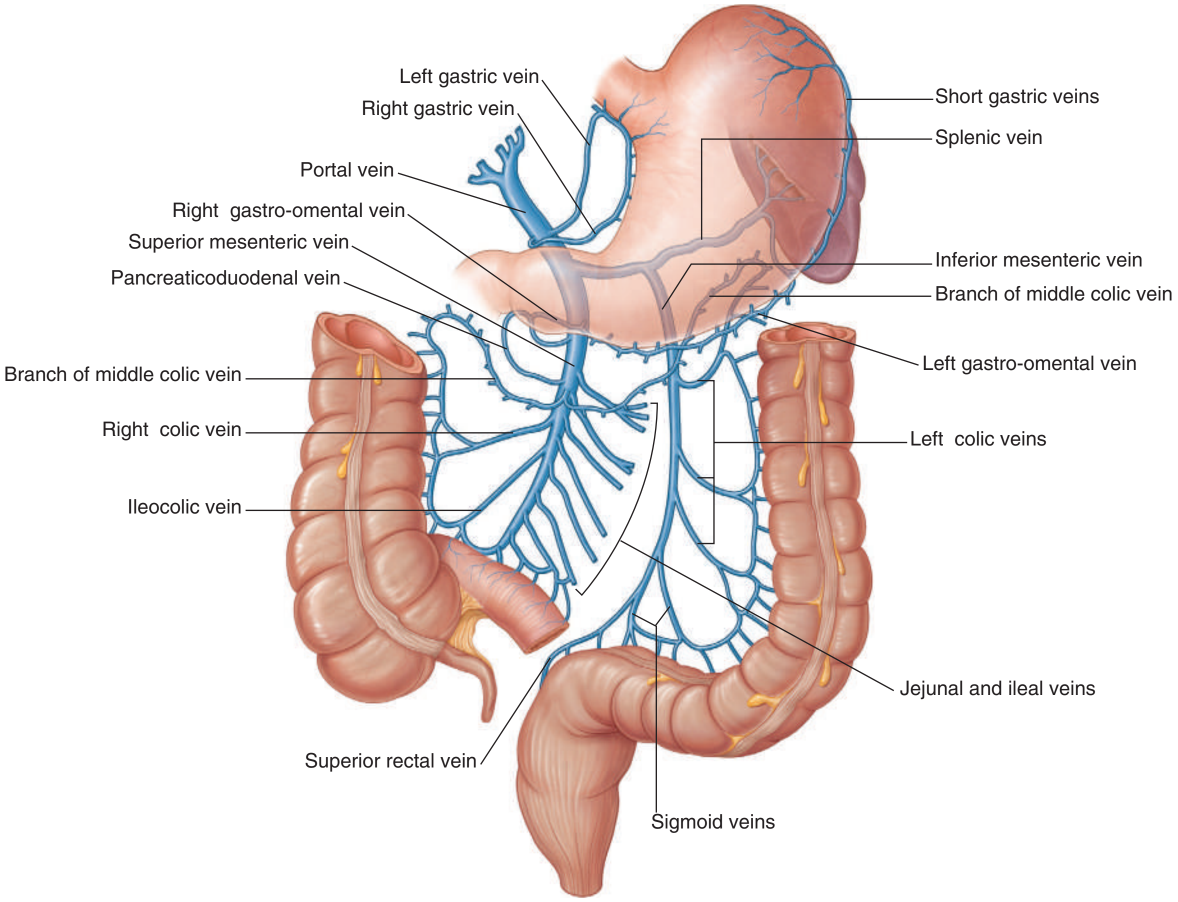

Left gastric vein
Right gastric vein
Portal vein
Right gastro-omental vein
Superior mesenteric vein
Pancreaticoduodenal vein
Branch of middle colic vein
Right colic vein
Ileocolic vein
Superior rectal vein
Sigmoid veins
Short gastric veins
Splenic vein
Inferior mesenteric vein
Branch of middle colic vein
Left gastro-omental vein
Left colic veins
Jejunal and ileal veins

Plate 12.3 Venous drainage of the abdominal portion of the gastrointestinal tract.

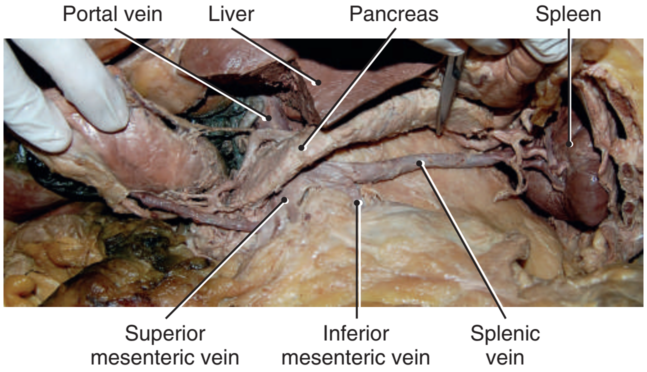
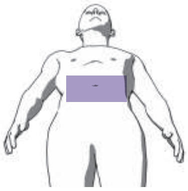

Portal vein
Liver
Pancreas
Spleen
Superior mesenteric vein
Inferior mesenteric vein
Splenic vein

Fig. 12.43 Trace the splenic vein to its junction with the superior mesenteric vein to form the portal vein.



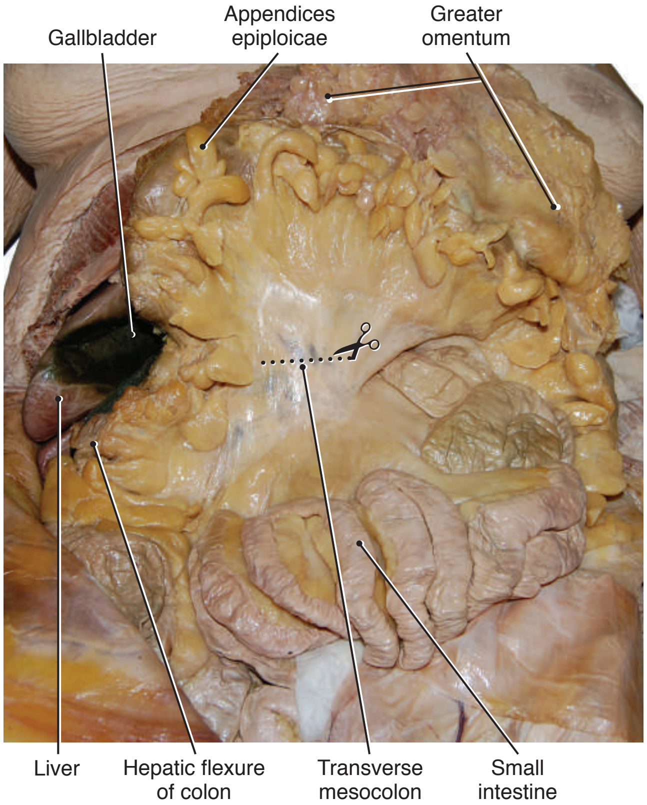
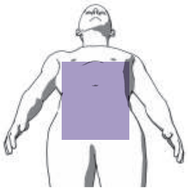

Gallbladder
Appendices epiploicae
Greater omentum
Liver
Hepatic flexure of colon
Transverse mesocolon
Small intestine

Fig. 12.45 Lift the transverse colon to see the transverse mesocolon.



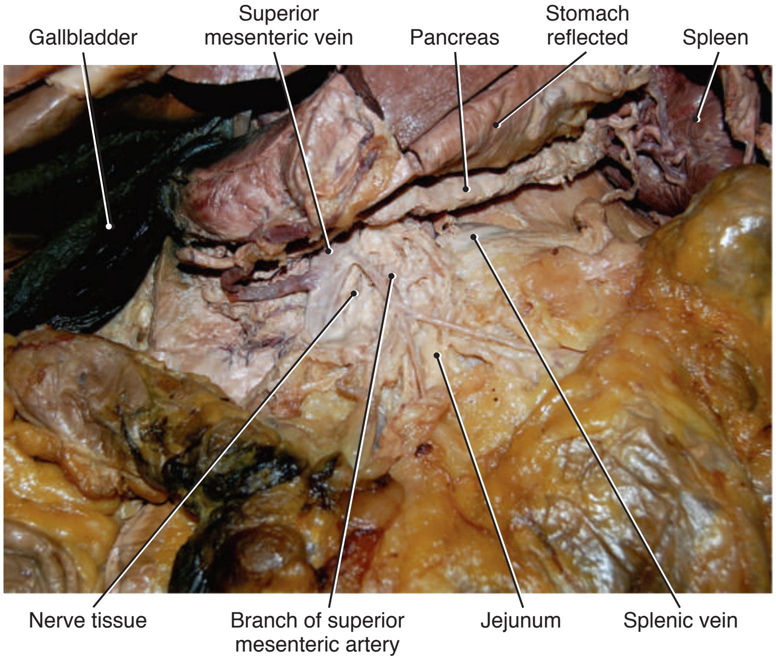
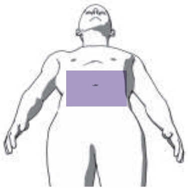

Gallbladder
Superior mesenteric vein
Pancreas
Stomach reflected
Spleen
Nerve tissue
Branch of superior mesenteric artery
Jejunum
Splenic vein

Fig. 12.44 Expose the tributaries of the superior mesenteric vein and arterial branches of the superior mesenteric artery.



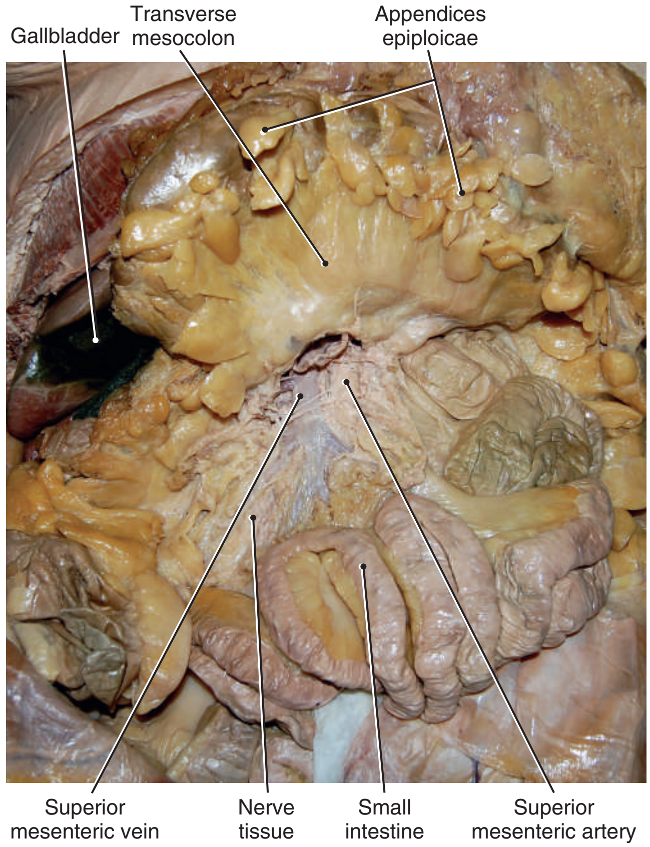
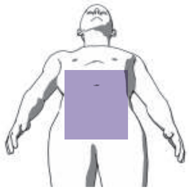

Gallbladder
Transverse mesocolon
Appendices epiploicae
Superior mesenteric vein
Nerve tissue
Small intestine
Superior mesenteric artery

Fig. 12.46 With your fingertips, penetrate the transverse mesocolon and expose the underlying superior mesenteric artery and vein.



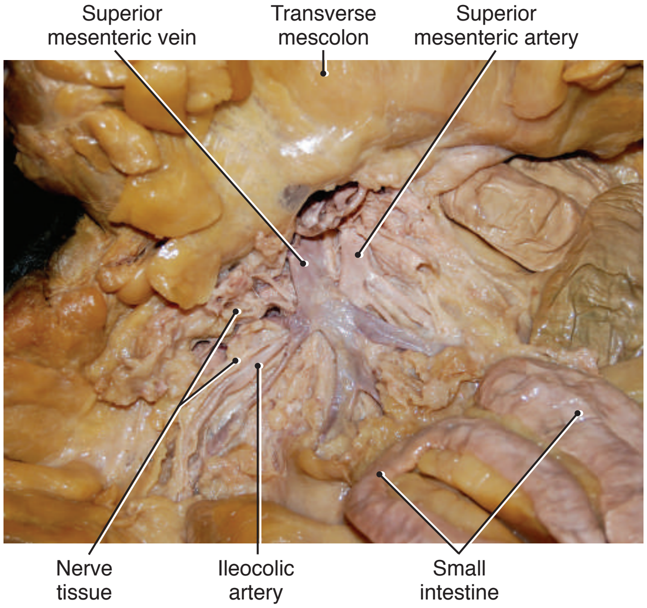
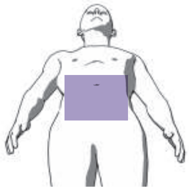

Superior mesenteric vein
Transverse mescolon
Superior mesenteric artery
Nerve tissue
Ileocolic artery
Small intestine

Fig. 12.47 Continue separating tributaries of the superior mesenteric vein and branches of the superior mesenteric artery from the fat and nerve tissue.



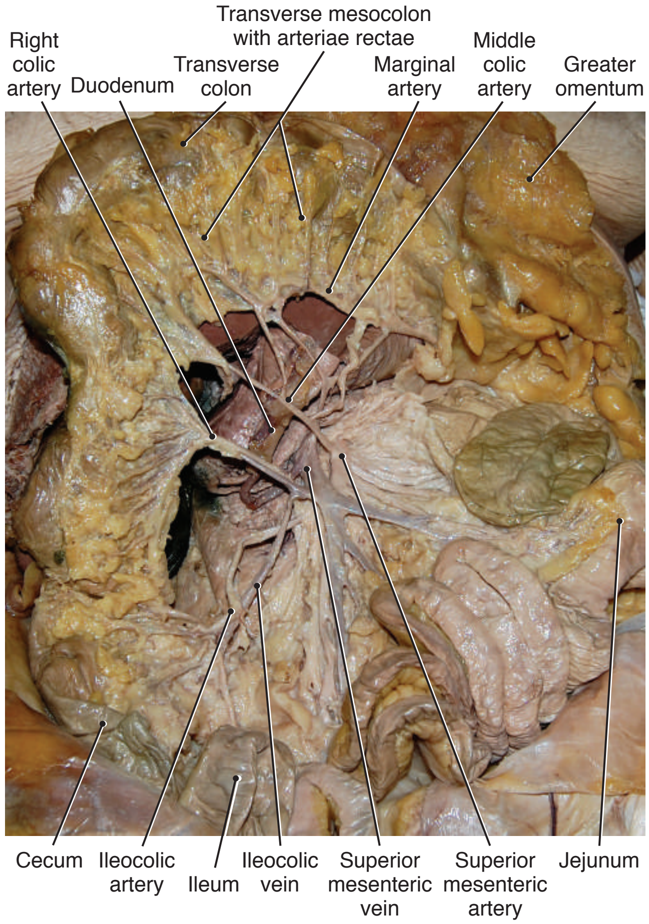
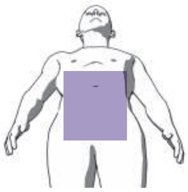

Right colic artery
Duodenum
Transverse mesocolon with arteriae rectae
Transverse colon
Marginal artery
Middle colic artery
Greater omentum
Cecum
Ileocolic artery
Ileum
Ileocolic vein
Superior mesenteric vein
Superior mesenteric artery
Jejunum

Fig. 12.48 Identify the ileocolic artery and trace it to the ileocecal junction.



○ Continue cleaning the branches of the superior mesenteric artery and the tributaries of the superior mesenteric vein from fat and nerve tissue (Fig. 12.47).

DISSECTION **TIP**

The ileocolic artery is fairly constant and provides a good landmark for this dissection (Fig. 12.48).

ANATOMY **NOTE**

The ileocolic artery gives rise to the appendicular artery supplying the appendix in its own mesentery, the *mesoappendix.*

○ Identify the ileocolic artery and trace it to the *ileocecal junction,* between the ileum and the cecum.

○ Identify the middle and right colic arteries that supply the transverse and the ascending colon, respectively (see Fig. 12.48).

○ Look for a branch of the middle colic artery, the marginal artery (of Drummond), that supplies the ascending, transverse, and descending colon, and anastomose with the left colic artery, a branch of the inferior mesenteric artery (see Fig. 12.52).

- Once the main three arterial branches of the *superior mesenteric artery* (middle colic, right colic and ileocolic) are identified, expose the ileal and jejunal arteries from their origin from the superior mesenteric artery to the margin of the ileum and jejunum.

DISSECTION **TIP**

Realize that the mesenteric fat is much more abundant in the ileal mesentery than in the jejunal mesentery.

- Dissect out the vascular arcades, appreciating their greater number in the ileum than in the jejunum (Fig. 12.49).
- Similarly, the vasa recti are shorter and more numerous in the ileum (Figs. 12.50 and 12.51).
- Once the dissection of the superior mesenteric vessels is concluded, lift the transverse colon and review all dissected structures dissected out (Figs. 12.52 and 12.53).
- Retract the small intestine to the right and expose the transverse, descending, and sigmoid colon (Fig. 12.54).

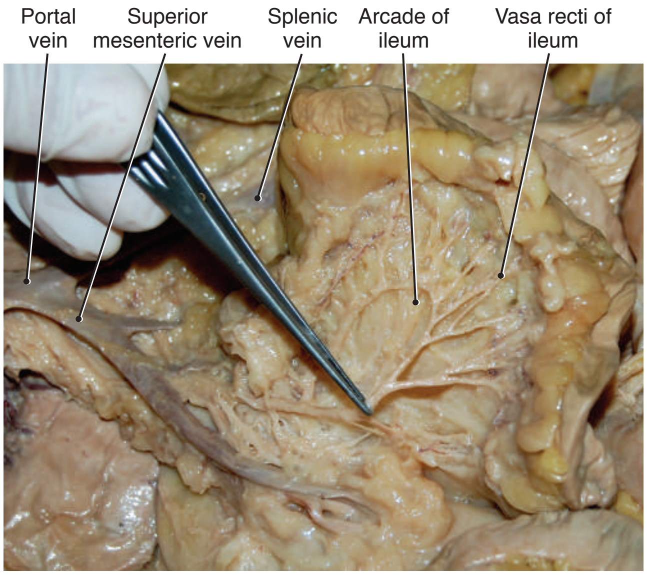
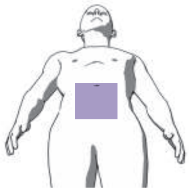

Portal vein
Superior mesenteric vein
Splenic vein
Arcade of ileum
Vasa recti of ileum

Fig. 12.50 Notice that the vasa recti are shorter and more numerous in the ileum than in the jejunum. Note the increased number of arcades in the ileum compared with the jejunum.



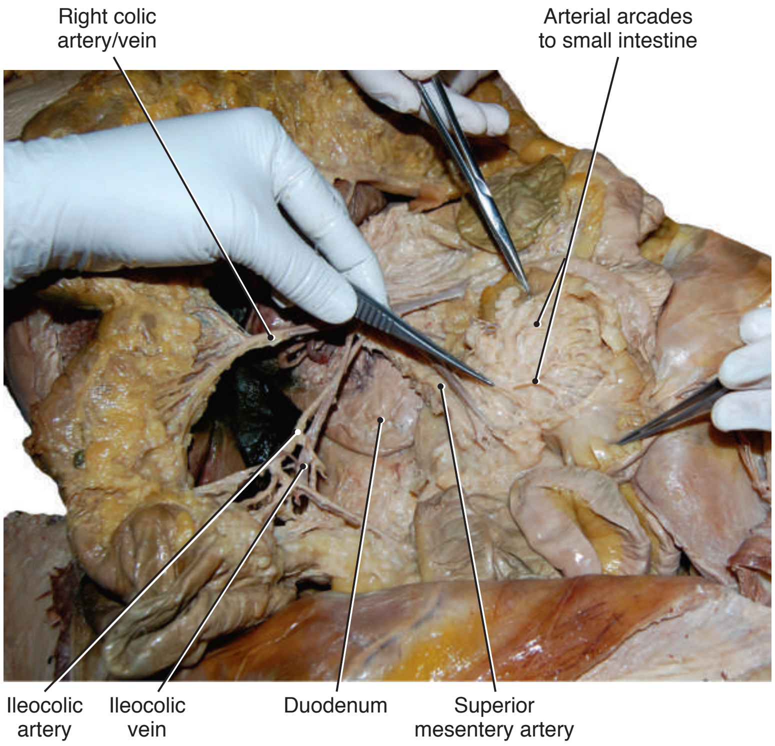
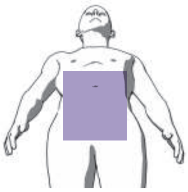

Right colic artery/vein
Arterial arcades to small intestine
Ileocolic artery
Ileocolic vein
Duodenum
Superior mesentery artery

Fig. 12.49 Dissect out the vascular arcades.



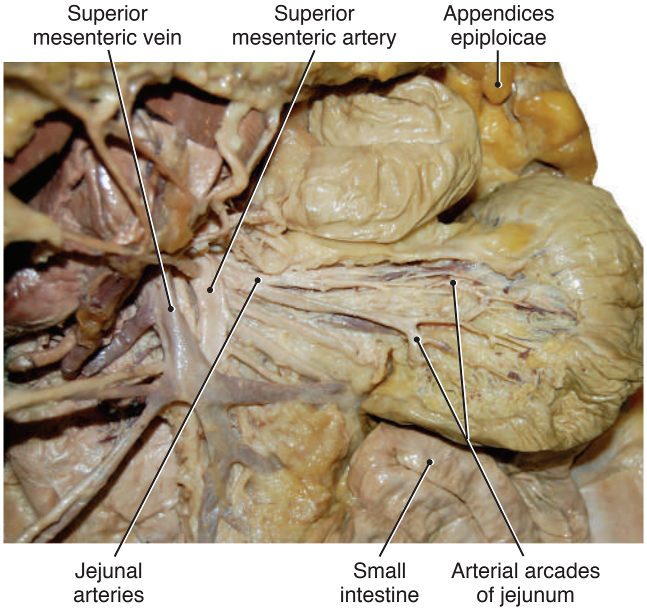
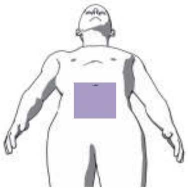

Superior mesenteric vein
Superior mesenteric artery
Appendices epiploicae
Jejunal arteries
Small intestine
Arterial arcades of jejunum

Fig. 12.51 Note the increased number of arcades in ileum compared with jejunum.



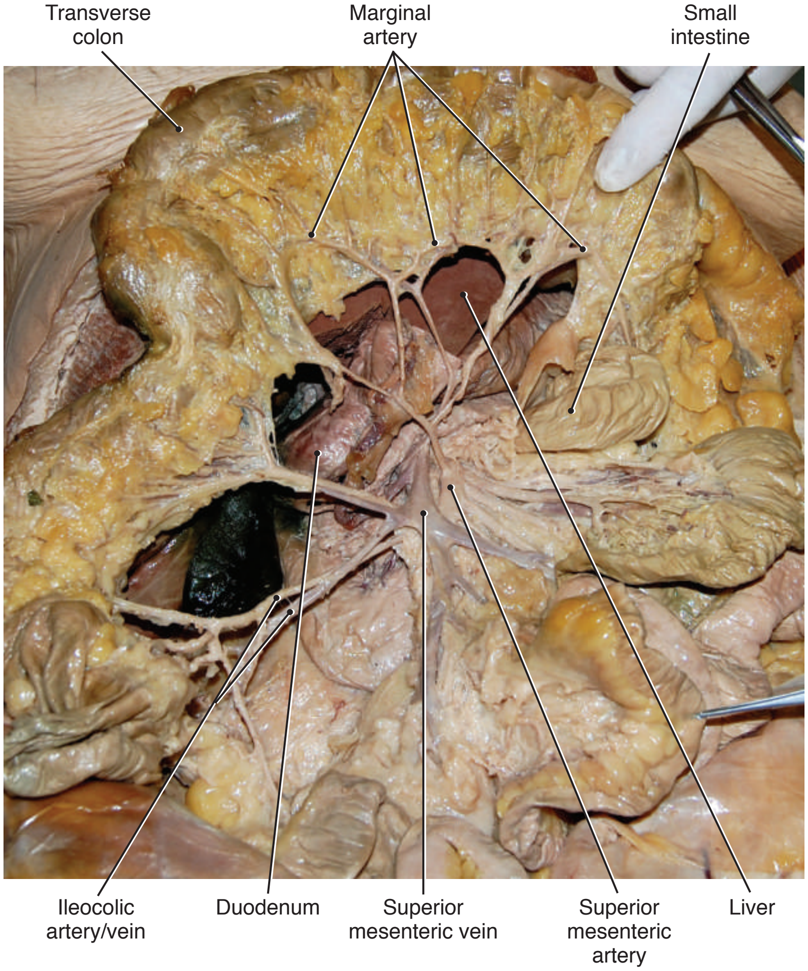
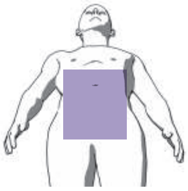

Transverse colon
Marginal artery
Small intestine
Ileocolic artery/vein
Duodenum
Superior mesenteric vein
Superior mesenteric artery
Liver

Fig. 12.52 Conclude the dissection of the superior mesenteric vessels.



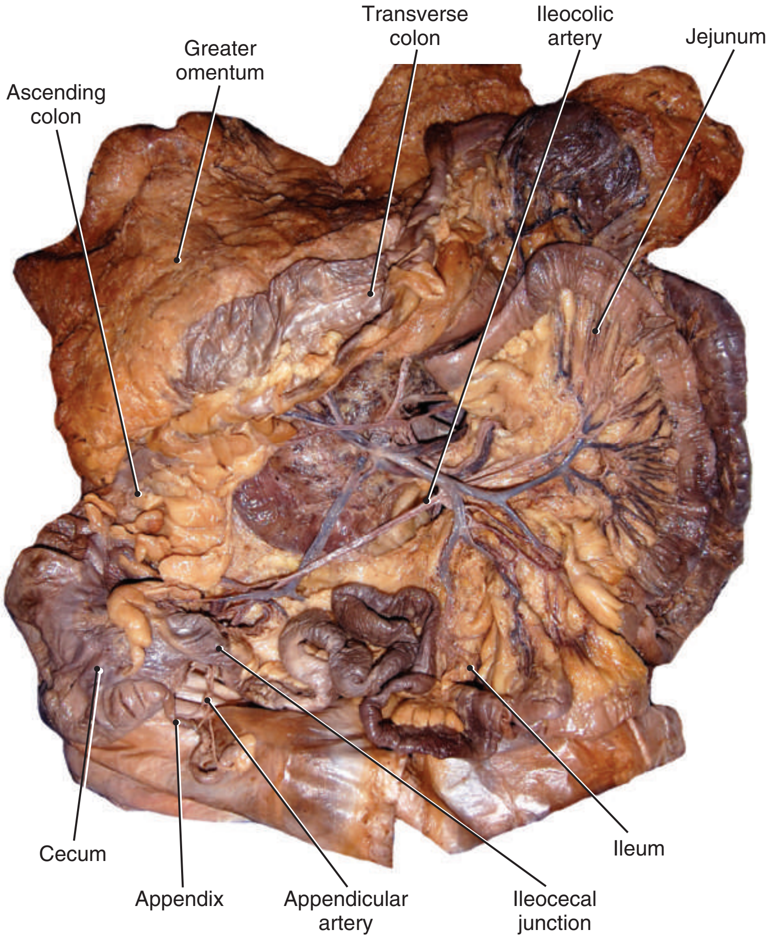

Ascending colon
Greater omentum
Transverse colon
Ileocolic artery
Jejunum
Cecum
Appendix
Appendicular artery
Ileocecal junction
Ileum

Fig. 12.53 Lift the transverse colon and review its related structures.

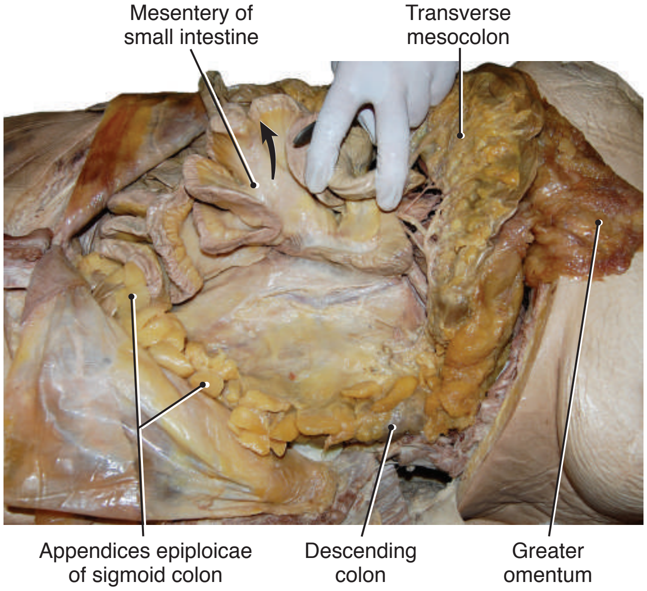
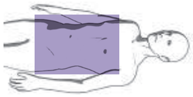

Mesentery of small intestine
Transverse mesocolon
Appendices epiploicae of sigmoid colon
Descending colon
Greater omentum

Fig. 12.54 Retract the small intestine to the right and expose the transverse, descending, and sigmoid colon.



- **With scissors, continue the exposure of the inferior mesenteric vein (Fig. 12.55) toward the margins of the colon.**
- **To the right or medial to the inferior mesenteric vein, identify the *inferior mesenteric artery* (Plate 12.4).**

DISSECTION **TIP**

Both the inferior mesenteric artery and the inferior mesenteric vein require additional effort to expose because of the dense nerve plexuses covering them. To facilitate the dissection of the branches of the inferior mesenteric artery, make a shallow incision between the lateral wall of the descending colon and the body at the white line of Toldt (left paracolic gutter), and release the descending colon from the peritoneum. In addition, do *not* remove the nerve plexus when you expose the inferior mesenteric vessels. This nerve tissue will be examined in a later dissection of the posterior abdominal wall.

- **Identify the branches of the inferior mesenteric artery, the left colic artery and the sigmoid arteries and fully expose them (Fig. 12.56).**

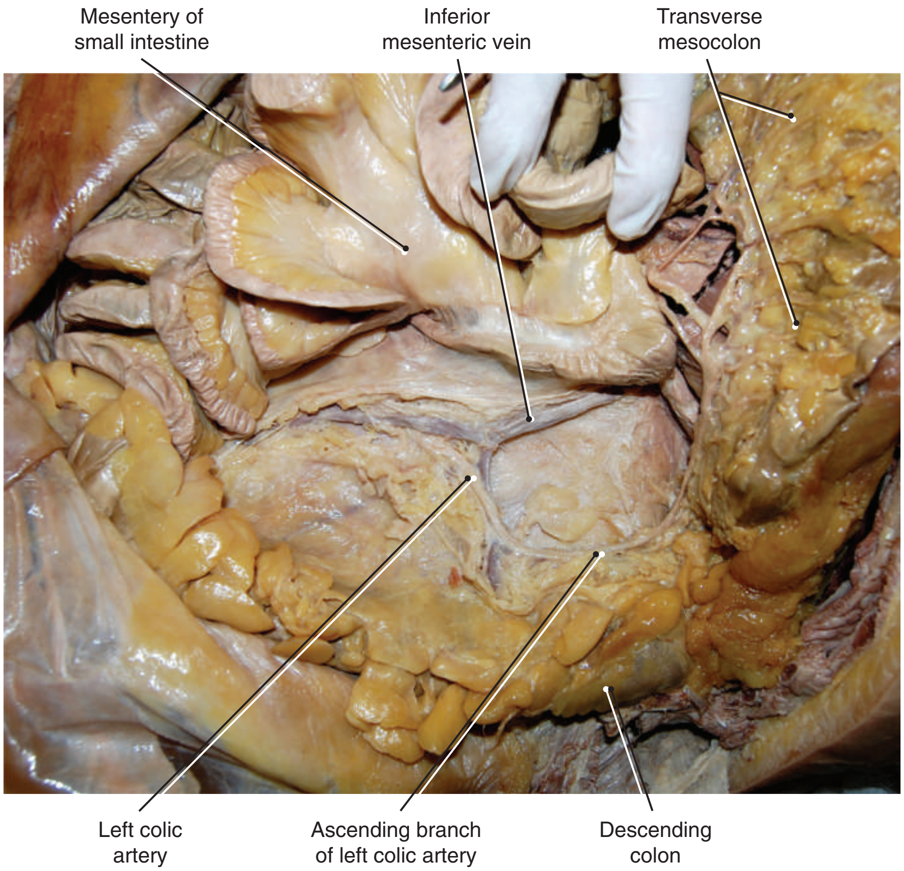
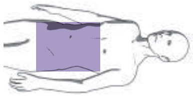

Mesentery of small intestine
Inferior mesenteric vein
Transverse mesocolon
Left colic artery
Ascending branch of left colic artery
Descending colon

Fig. 12.55 With scissors, continue the exposure of the inferior mesenteric vein.



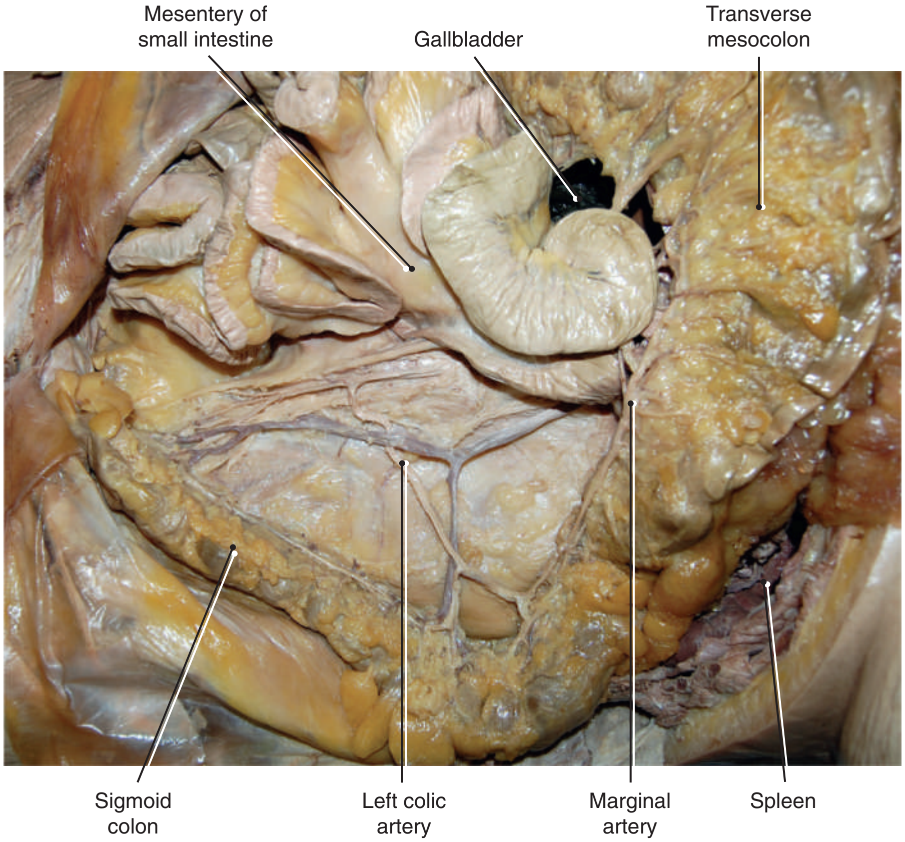
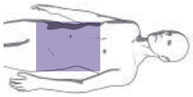

Mesentery of small intestine
Gallbladder
Transverse mesocolon
Sigmoid colon
Left colic artery
Marginal artery
Spleen

Fig. 12.56 Identify and fully expose the branches of inferior mesenteric artery, left colic artery, and sigmoid arteries.



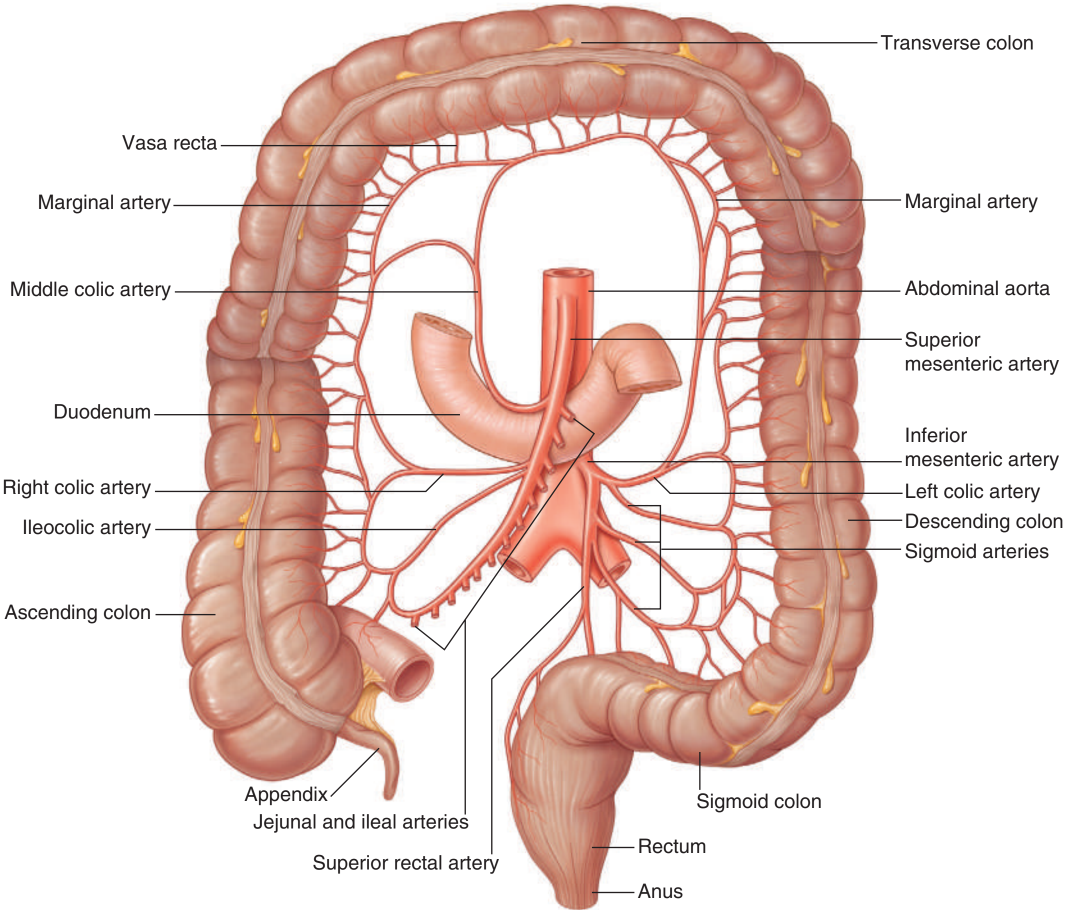

Transverse colon
Vasa recta
Marginal artery
Marginal artery
Middle colic artery
Abdominal aorta
Superior mesenteric artery
Duodenum
Inferior mesenteric artery
Right colic artery
Left colic artery
Ileocolic artery
Descending colon
Sigmoid arteries
Ascending colon
Appendix
Jejunal and ileal arteries
Sigmoid colon
Rectum
Superior rectal artery
Anus

Plate 12.4 Superior and inferior mesenteric arteries.

IF TIME PERMITS

- Tie two strings close together around the proximal segment of the jejunum, and cut between them.
- Perform the same technique along a distal portion of the ileum.
- Clean the two segments and observe their internal morphology.
- Note the increased number of plicae circulares and villi, as well as increased wall thickness in the jejunum compared to the ileum.
- Similarly, place a ligature at the ileocecal junction and another ligature at the midportion of the ascending colon.
- Remove this segment and examine its internal morphology.
- Identify the ileocecal valve and the plicae semilunares coli.

LABORATORY IDENTIFICATION CHECKLIST

ARTERIES

- ☐ Abdominal aorta
- ☐ Celiac trunk
  - ☐ Common hepatic
  - ☐ Proper hepatic
  - ☐ Gastroduodenal
  - ☐ Right gastroepiploic
  - ☐ Right gastric
  - ☐ Splenic
  - ☐ Short gastrics
  - ☐ Left gastric
  - ☐ Left gastroepiploic
- ☐ Superior mesenteric artery
  - ☐ Ileocolic
  - ☐ Appendicular
  - ☐ Right colic
  - ☐ Middle colic
- ☐ Inferior mesenteric
  - ☐ Left colic
  - ☐ Sigmoid
  - ☐ Inferior rectal
- ☐ Marginal (formed between ileocolic [right, middle] and left colic arteries)
- ☐ Jejunal and ileal arteries (arcades) and recti branches

VEINS

- ☐ Inferior vena cava
  - ☐ Hepatic
- ☐ Portal
  - ☐ Superior mesenteric
  - ☐ Splenic
  - ☐ Inferior mesenteric

LYMPH NODES

- ☐ Mesenteric

MUSCLES

- ☐ External abdominal oblique
- ☐ Internal abdominal oblique
  - ☐ Cremaster
- ☐ Transversus abdominis
- ☐ Rectus abdominis
- ☐ Pyramidalis
- ☐ Crus (right and left) of diaphragm
- ☐ Psoas major
- ☐ Quadratus lumborum

CONNECTIVE TISSUE

- ☐ External oblique aponeurosis
- ☐ Greater omentum
- ☐ Lesser omentum
- ☐ Transverse mesocolon
- ☐ Sigmoid mesentery
- ☐ Appendicular mesentery
- ☐ Dorsal root mesentery

Liver

- ☐ Falciform ligament
- ☐ Ligamentum teres

VISCERA/ORGANS

Esophagus

- ☐ Abdominal esophagus

Stomach

- ☐ Fundus
- ☐ Body
- ☐ Cardia
- ☐ Pylorus
- ☐ Greater curvature
- ☐ Lesser curvature

Small Intestine

- ☐ Duodenum
- ☐ Jejunum
- ☐ Ileum

Large Intestine

- ☐ Cecum
- ☐ Appendix
- ☐ Ascending colon
- ☐ Transverse colon
- ☐ Descending colon
- ☐ Sigmoid colon
- ☐ Appendices epiploicae
- ☐ Teniae coli

Liver

- ☐ Left lobe
- ☐ Right lobe
- ☐ Caudate
- ☐ Quadrate

Gallbladder

☐ Fundus
☐ Body
☐ Neck

Pancreas

☐ Head
☐ Neck
☐ Body
☐ Tail
☐ Uncinate process

Spleen

☐ Splenic notch
☐ Hilum

CHAPTER 13 POSTERIOR ABDOMINAL WALL

ATLAS REFERENCES

Netter: 265–269, 300, 311–323
McMinn: 253–261
Gray's Atlas: 183–196, 198–199

EXPOSING THE KIDNEYS

- Cut the white lines of Toldt (paracolic gutters) along the edges of the ascending and the descending colon, and reflect the large and small intestines to the left of the abdominal cavity (Fig. 13.1).
- With your fingers, retract the duodenum and pancreas to the left, without disrupting their vascular supply (Fig. 13.2).
- Palpate the abdominal aorta on the left and the *inferior vena cava* (IVC) on the right.
- With scissors, cut the peritoneum of the posterior abdominal wall and expose the IVC (Fig. 13.3).
- To the right of the IVC, dissect out the perirenal (renal) fascia (of Gerota), which is filled predominantly with abundant perirenal fat (Fig. 13.4).
- Trace the right ureter; expose its course from the kidney to the pelvic brim and as it crosses over the iliac arteries.
- Remove the fat posterior to the kidney, known as the *pararenal* fat (Fig. 13.5).

DISSECTION **TIP**

For the removal of the perirenal and pararenal fat, use scissors or a probe and scrape it from the kidney capsule.

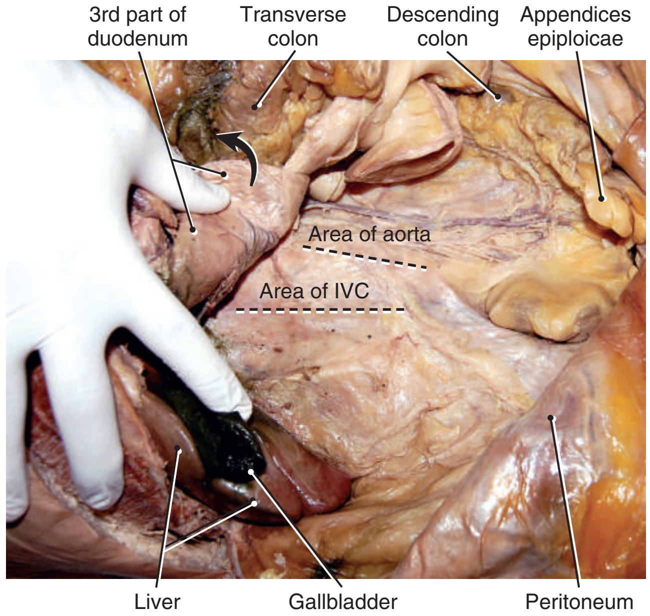
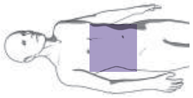

3rd part of duodenum
Transverse colon
Descending colon
Appendices epiploicae
Area of aorta
Area of IVC
Liver
Gallbladder
Peritoneum

Fig. 13.2 Left duodenum and pancreas retracted. *IVC*, Inferior vena cava.



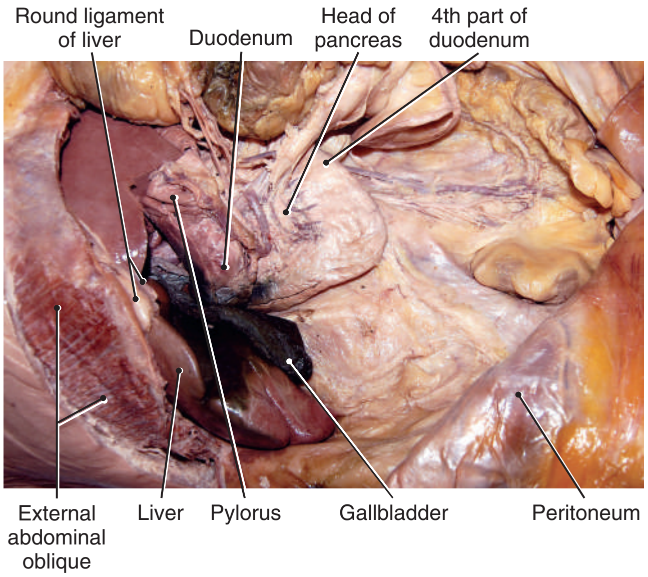
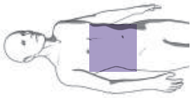

Round ligament of liver
Duodenum
Head of pancreas
4th part of duodenum
External abdominal oblique
Liver
Pylorus
Gallbladder
Peritoneum

Fig. 13.1 Lines of Toldt cut along edges of ascending and descending colon with large and small intestines reflected to left of abdominal cavity.



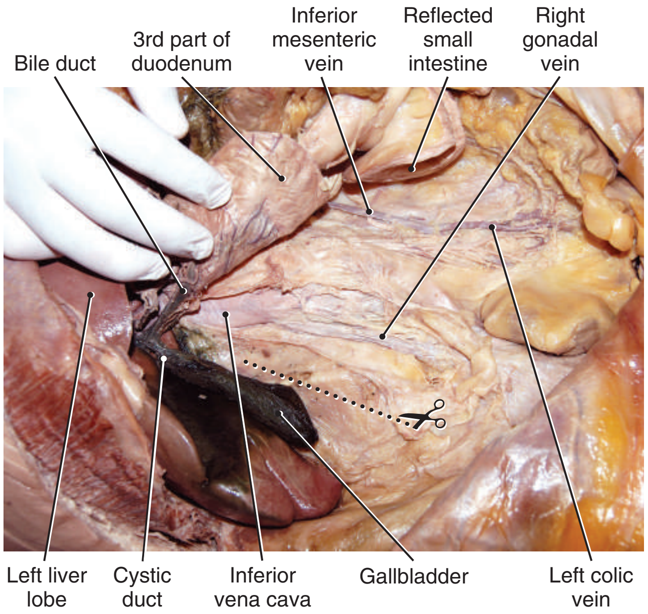
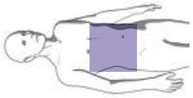

Bile duct
3rd part of duodenum
Inferior mesenteric vein
Reflected small intestine
Right gonadal vein
Left liver lobe
Cystic duct
Inferior vena cava
Gallbladder
Left colic vein

Fig. 13.3 Peritoneum of posterior abdominal wall incised to expose the inferior vena cava (IVC).



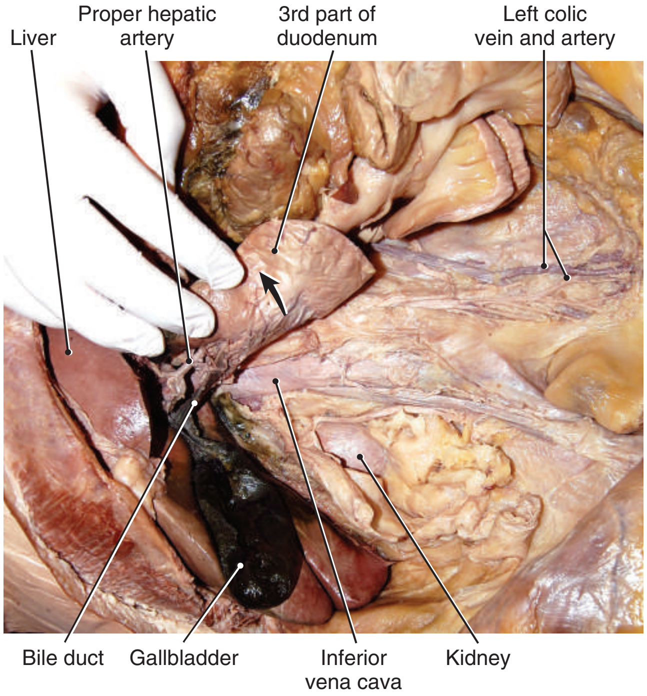

Liver
Proper hepatic artery
3rd part of duodenum
Left colic vein and artery
Bile duct
Gallbladder
Inferior vena cava
Kidney

Fig. 13.4 Perirenal fascia (of Gerota) dissected to the right of the IVC.

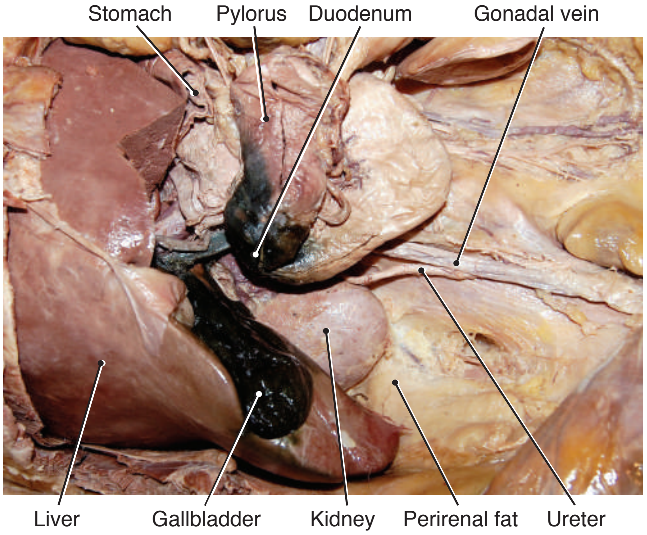

Stomach
Pylorus
Duodenum
Gonadal vein
Liver
Gallbladder
Kidney
Perirenal fat
Ureter

Fig. 13.5 Right ureter exposed as it leaves the right kidney, toward the pelvic brim and over the iliac arteries. Pararenal fat has been removed posterior to the kidney.

- Remove enough fascia and adipose tissue to clearly expose the kidneys and suprarenal glands. Free up the margins of the suprarenal glands, taking care to preserve their blood vessels, especially along their medial borders.
- Remove all fat from the posterior part of the kidney capsule.

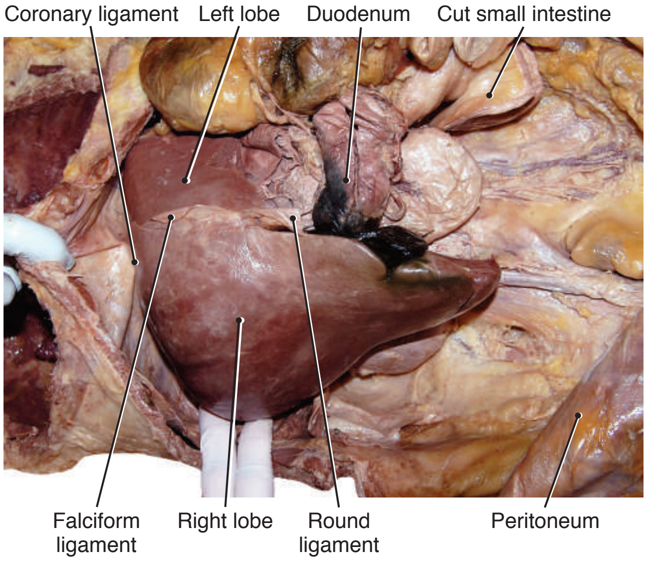

Coronary ligament
Left lobe
Duodenum
Cut small intestine
Falciform ligament
Right lobe
Round ligament
Peritoneum

Fig. 13.6 Falciform, left triangular, and coronary ligaments cut and right triangular ligament incised on lifting liver.

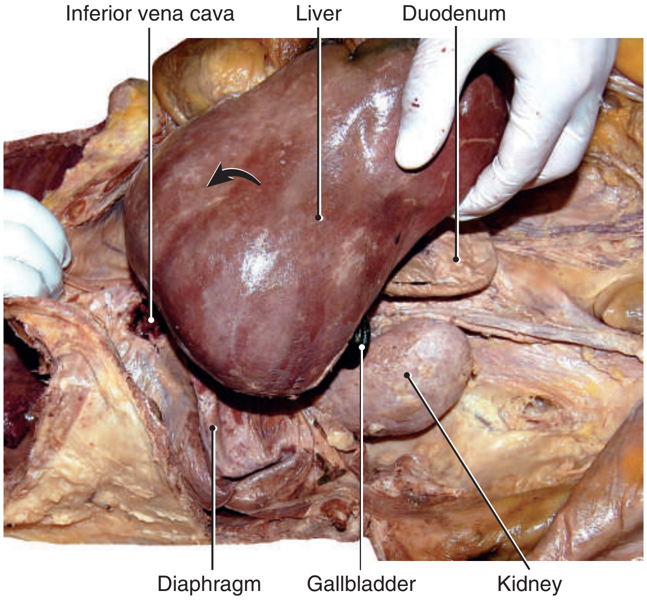

Inferior vena cava
Liver
Duodenum
Diaphragm
Gallbladder
Kidney

Fig. 13.7 With liver pulled inferiorly, cut the IVC in the space between superior aspect of the liver and the undersurface of the diaphragm.

LIVER

- Reflect the liver medially and expose the entire posterior abdominal wall.
- Cut the falciform, left triangular, and coronary ligaments.
- Place your fingertips underneath the lateral side of the liver, lift it up slightly, and cut the right triangular ligament (Fig. 13.6).
- Pull the liver inferiorly, and in the space between the diaphragm and the liver, cut the IVC (Fig. 13.7).

- Lift the liver upward and to the left; expose the infrahepatic portion of IVC away from the body wall (Fig. 13.8).
- Gently pull the liver to the left; otherwise, you will damage the right suprarenal vein as it enters the IVC.
- With a scalpel, make an incision through the IVC superior to the level of the renal veins and reflect the liver to the left (Fig. 13.9).
- The liver is attached to the abdominal cavity only by the portal vein, hepatic artery, and bile duct.
- On the reflected liver, identify the right and left lobes (divided by the falciform ligament), as well as the quadrate and caudate lobes of the right lobe.
- Identify the fissure for the ligamentum venosum and the ligamentum teres (round ligament) of the liver.
- Identify the round ligament, left triangular ligament, and coronary ligament (Fig. 13.10).
- To identify the ligamentum venosum, reflect the caudate lobe and clean the fissure for the ligament (Fig. 13.11).
- Reflect the inferior vena cava slightly inferiorly and expose the suprarenal gland and the bare area of the liver (Fig. 13.12).

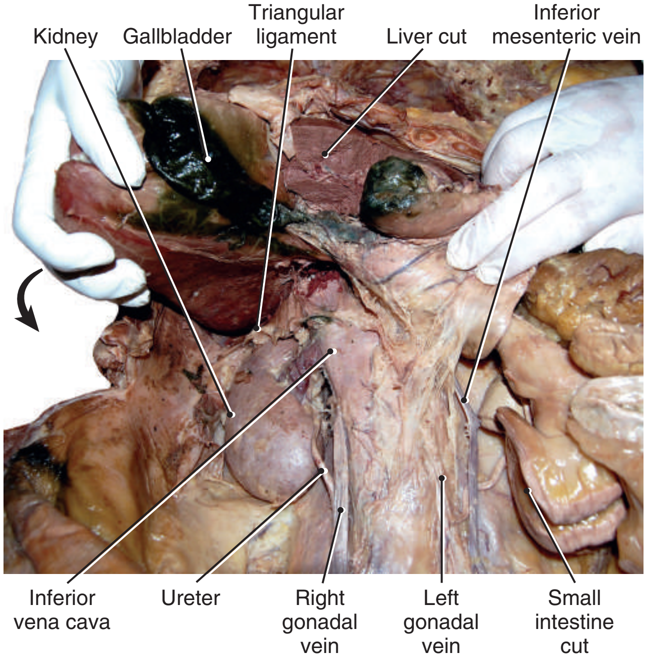
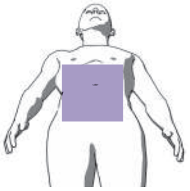

Kidney
Gallbladder
Triangular ligament
Liver cut
Inferior mesenteric vein
Inferior vena cava
Ureter
Right gonadal vein
Left gonadal vein
Small intestine cut

Fig. 13.8 Liver lifted upward and to the left exposing infrahepatic portion of IVC.



KIDNEYS AND SUPRARENAL GLANDS

- Clean out the connective tissue and fat over the IVC and expose the right gonadal vein and right and left renal veins (Figs. 13.13 and 13.14).
- Continue the exposure of the left renal vein to the left and clean away the fat and connective tissue over the abdominal aorta (Fig. 13.15).

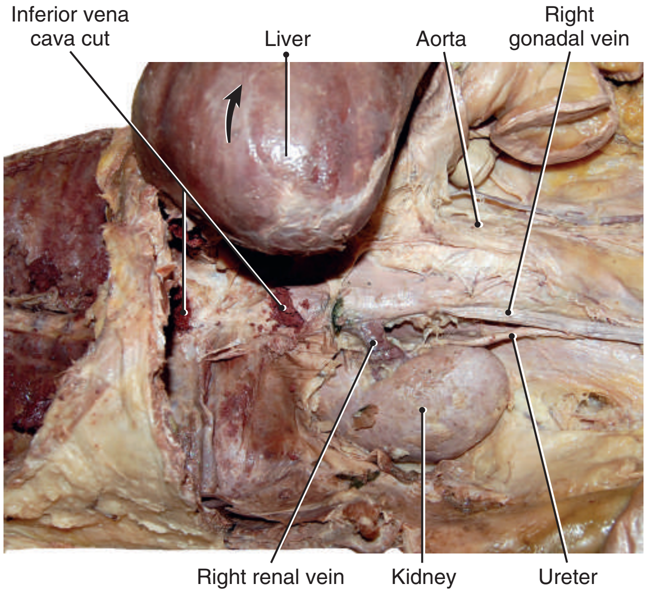
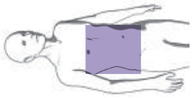

Inferior vena cava cut
Liver
Aorta
Right gonadal vein
Right renal vein
Kidney
Ureter

Fig. 13.9 Incision through IVC superior to level of renal veins, with liver reflected.



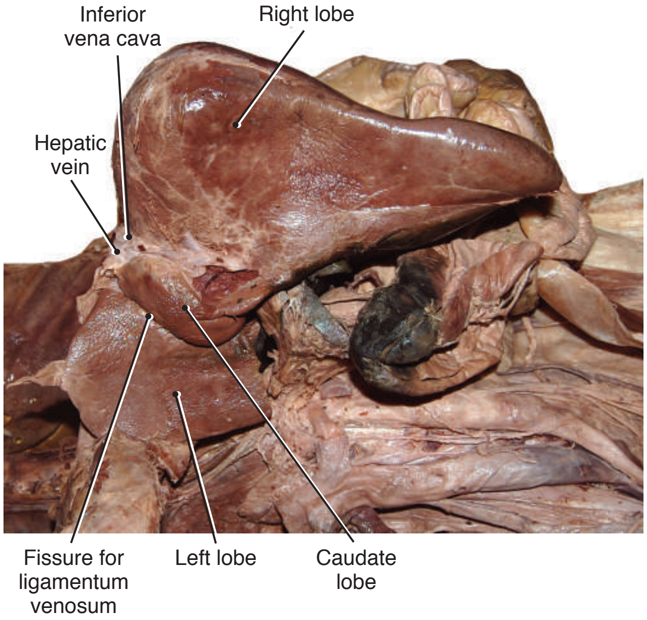

Inferior vena cava
Right lobe
Hepatic vein
Fissure for ligamentum venosum
Left lobe
Caudate lobe

Fig. 13.10 Identify the right and left lobes of the liver. Trace the inferior vena cava and the hepatic vein. Identify the fissure for the ligamentum venosum between the left lobe of the liver and the caudate lobe.

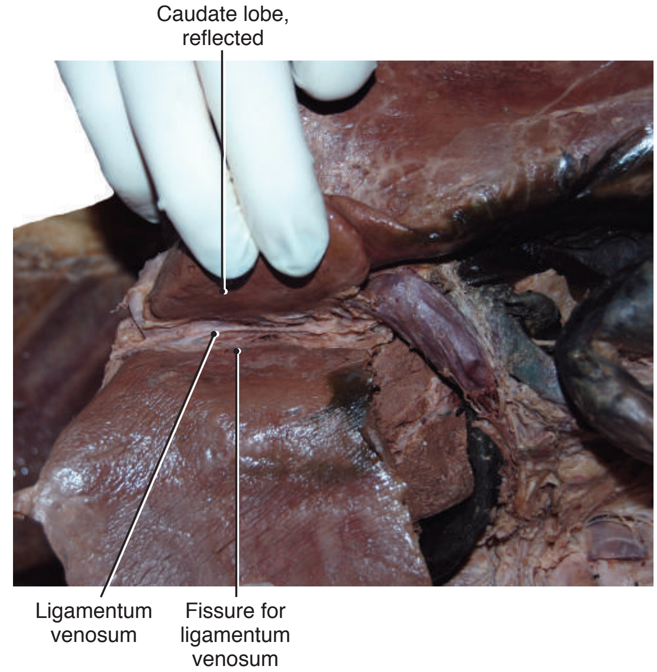

Caudate lobe, reflected
Ligamentum venosum
Fissure for ligamentum venosum

Fig. 13.11 Caudate lobe reflected and fissure cleaned to locate the ligamentum venosum.

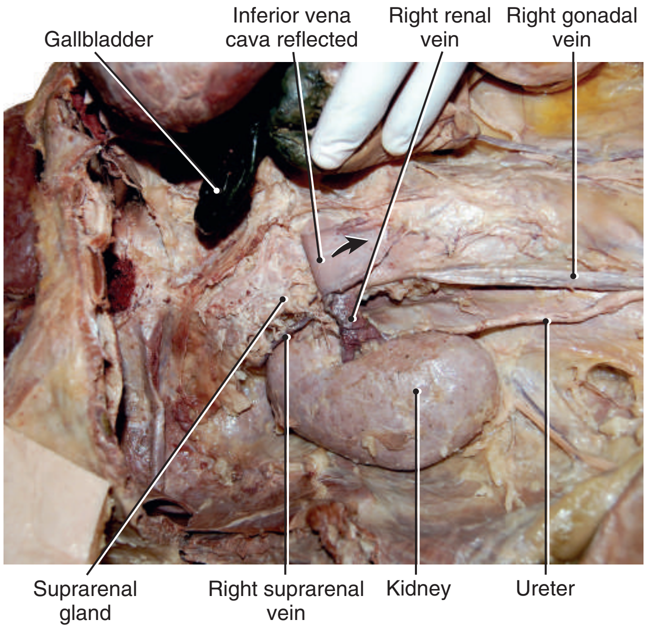
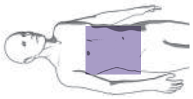

Gallbladder
Inferior vena cava reflected
Right renal vein
Right gonadal vein
Suprarenal gland
Right suprarenal vein
Kidney
Ureter

Fig. 13.12 Suprarenal gland and bare area of liver exposed by reflecting the IVC slightly inferiorly.



- ○ Paying special attention, identify the gonadal artery arising from the aorta just inferior to the level of the right renal vein.
- ○ In the space between the IVC and aorta, identify the right lymphatic trunk and the sympathetic fibers ascending from the superior hypogastric plexus. This plexus is located just anterior to the promontory of the sacrum (Fig. 13.16).

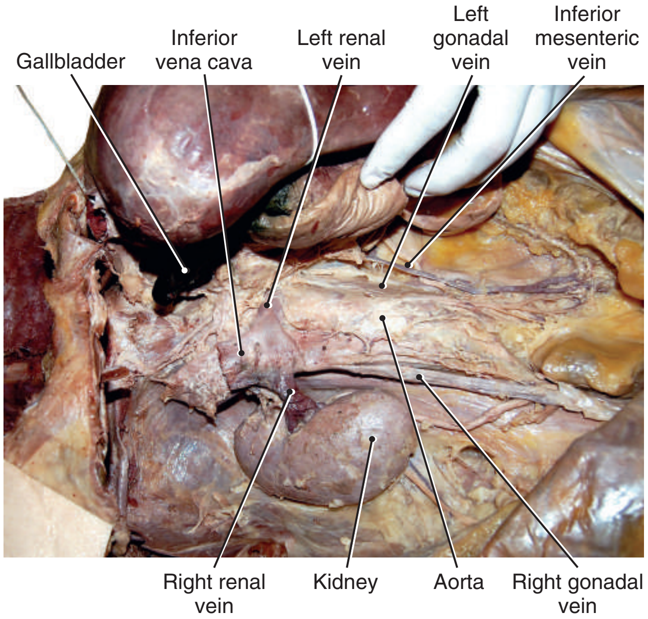
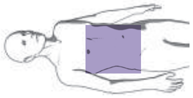

Gallbladder
Inferior vena cava
Left renal vein
Left gonadal vein
Inferior mesenteric vein
Right renal vein
Kidney
Aorta
Right gonadal vein

Fig. 13.13 Fat and connective tissue cleaned over IVC, exposing right gonadal vein and right renal vein.



- ○ Complete the dissection by exposing the branches of the *inferior mesenteric artery* (Figs. 13.17 and 13.18).
- ○ Identify and expose the renal arteries and veins.

ANATOMY **NOTE**

The left renal vein crosses over the aorta, inferior to the origin of the superior mesenteric artery, to reach the IVC. In contrast, the right renal artery passes posterior to the IVC (Fig. 13.19).

DISSECTION **TIP**

Additional renal arteries are often seen arising from the aorta; these are normal variations.

- ○ Identify the right suprarenal gland with its connection between the right suprarenal vein and the IVC (see Fig. 13.12). This vein is very short.
- ○ Dissect out the right superior, middle, and inferior suprarenal arteries, typically arising from the inferior phrenic artery, aorta, and renal artery, respectively (Fig. 13.20).
- ○ Notice the drainage of the right gonadal vein directly into the IVC (Plate 13.1).
- ○ Identify the left suprarenal gland, and expose the left suprarenal vein and left gonadal vein draining into the left renal vein.
- ○ With a scalpel, make a coronal incision and expose the outer cortex, as well as the inner medulla, of the suprarenal gland.

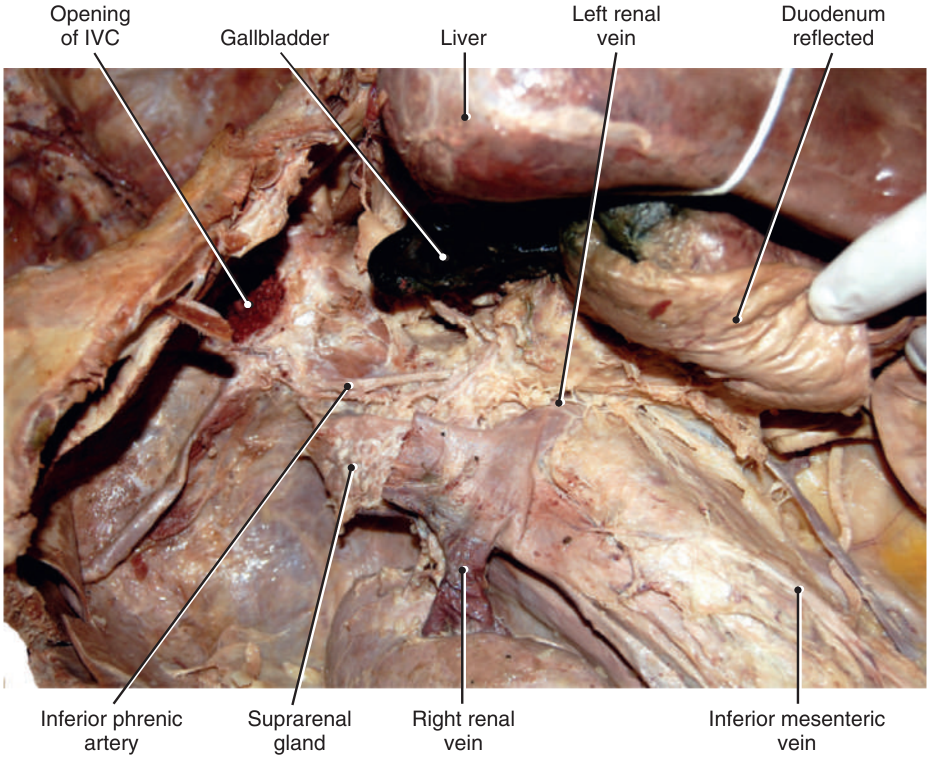
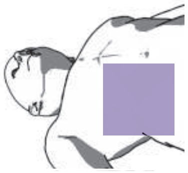

Opening of IVC
Gallbladder
Liver
Left renal vein
Duodenum reflected
Inferior phrenic artery
Suprarenal gland
Right renal vein
Inferior mesenteric vein

Fig. 13.14 Left renal vein exposed. *IVC*, Inferior vena cava.



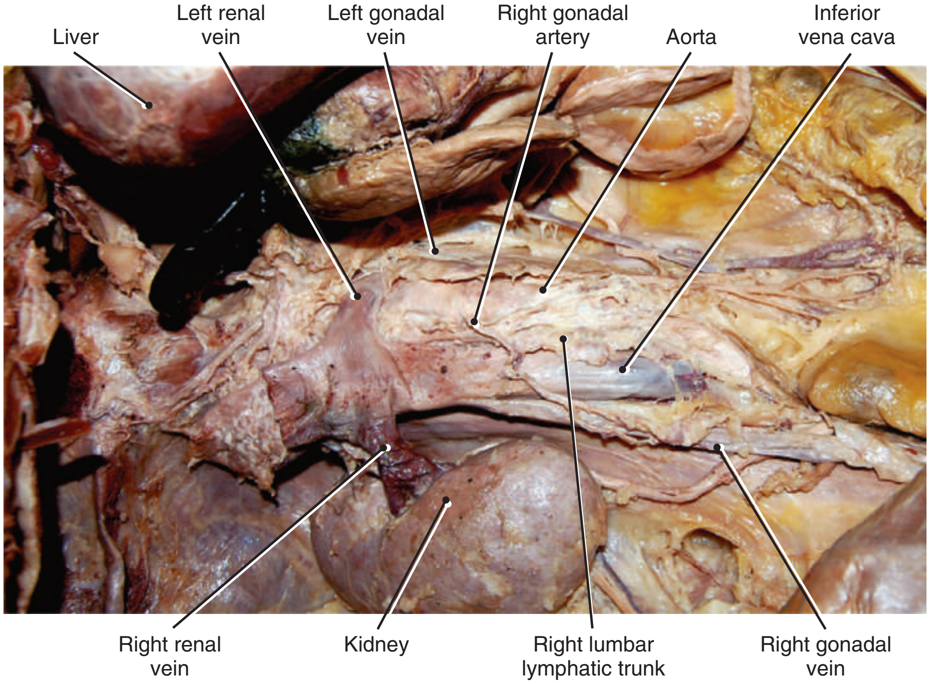
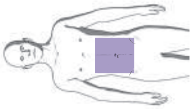

Liver
Left renal vein
Left gonadal vein
Right gonadal artery
Aorta
Inferior vena cava
Right renal vein
Kidney
Right lumbar lymphatic trunk
Right gonadal vein

Fig. 13.15 Left renal vein exposed, showing left gonadal vein, with gonadal artery from aorta just inferior to right renal vein.



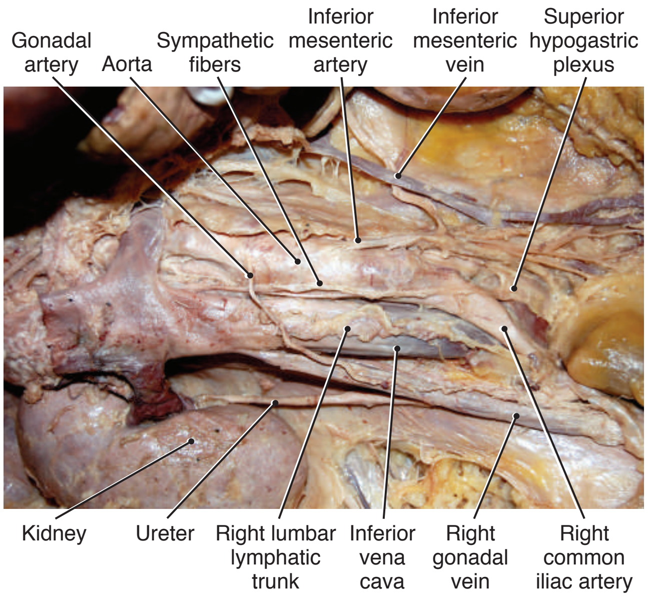

Gonadal artery
Aorta
Sympathetic fibers
Inferior mesenteric artery
Inferior mesenteric vein
Superior hypogastric plexus
Kidney
Ureter
Right lumbar lymphatic trunk
Inferior vena cava
Right gonadal vein
Right common iliac artery

Fig. 13.16 Right lymphatic trunk and sympathetic fibers ascending from superior hypogastric plexus.

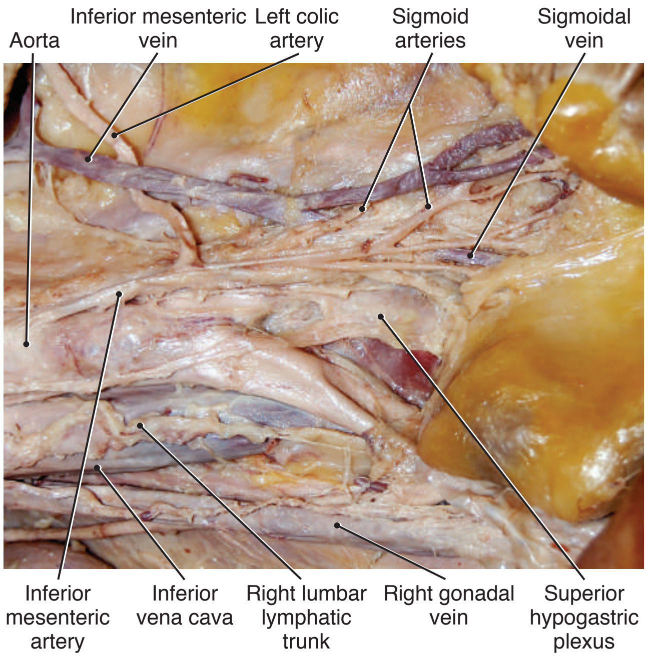

Aorta
Inferior mesenteric vein
Left colic artery
Sigmoid arteries
Sigmoidal vein
Inferior mesenteric artery
Inferior vena cava
Right lumbar lymphatic trunk
Right gonadal vein
Superior hypogastric plexus

Fig. 13.17 Dissection completed by exposing inferior mesenteric artery.

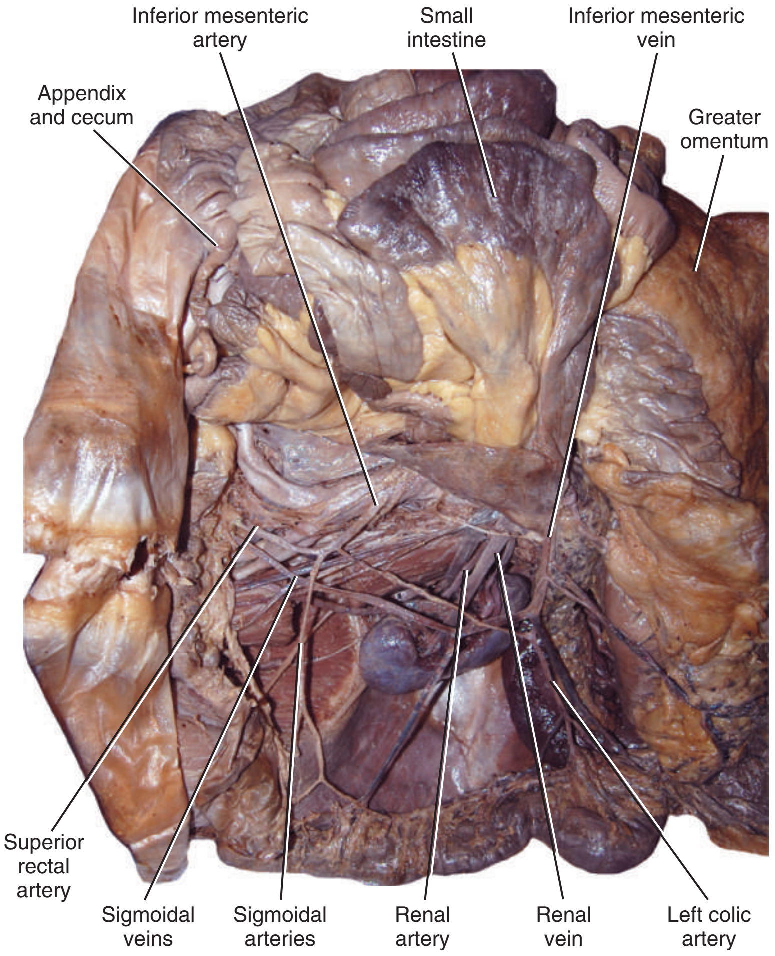

Inferior mesenteric artery
Small intestine
Inferior mesenteric vein
Appendix and cecum
Greater omentum
Superior rectal artery
Sigmoidal veins
Sigmoidal arteries
Renal artery
Renal vein
Left colic artery

Fig. 13.18 Structures of the abdominal wall.

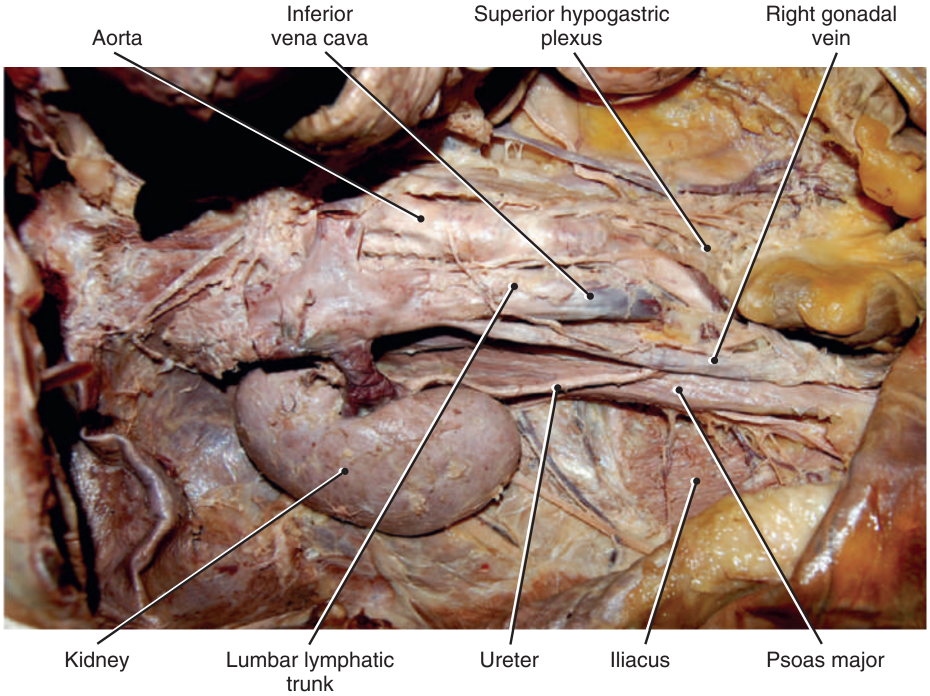
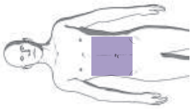

Aorta
Inferior vena cava
Superior hypogastric plexus
Right gonadal vein
Kidney
Lumbar lymphatic trunk
Ureter
Iliacus
Psoas major

Fig. 13.19 Locate and expose the renal arteries and veins.



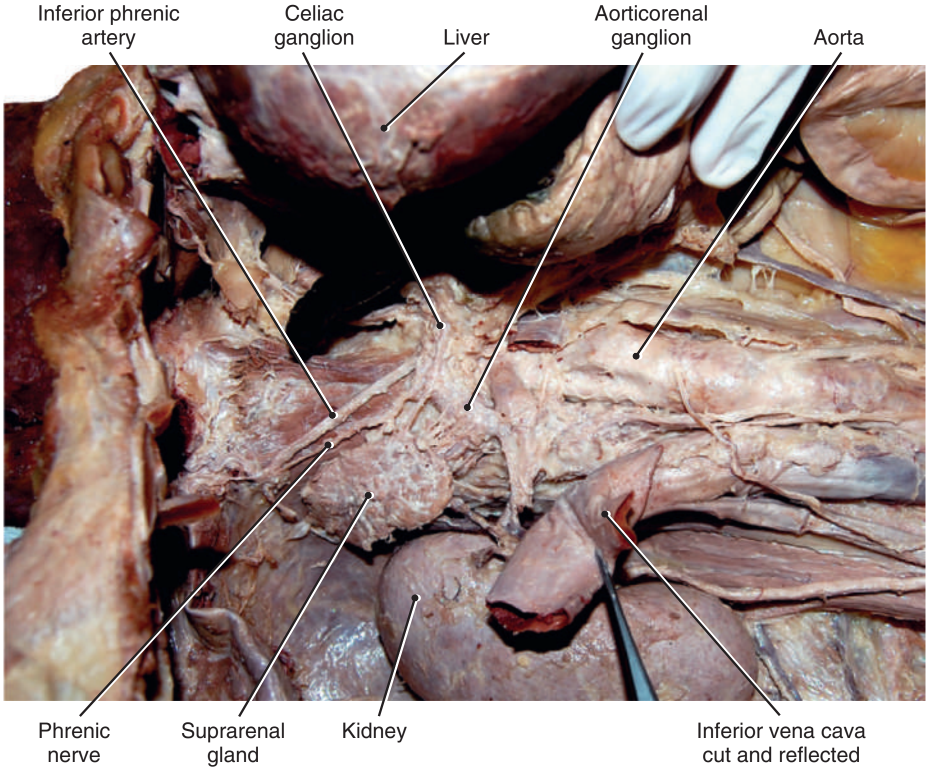
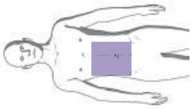

Inferior phrenic artery
Celiac ganglion
Liver
Aorticorenal ganglion
Aorta
Phrenic nerve
Suprarenal gland
Kidney
Inferior vena cava cut and reflected

Fig. 13.20 Dissect the right superior, middle, and inferior suprarenal arteries typically arising from the inferior phrenic artery, aorta, and renal artery, respectively.



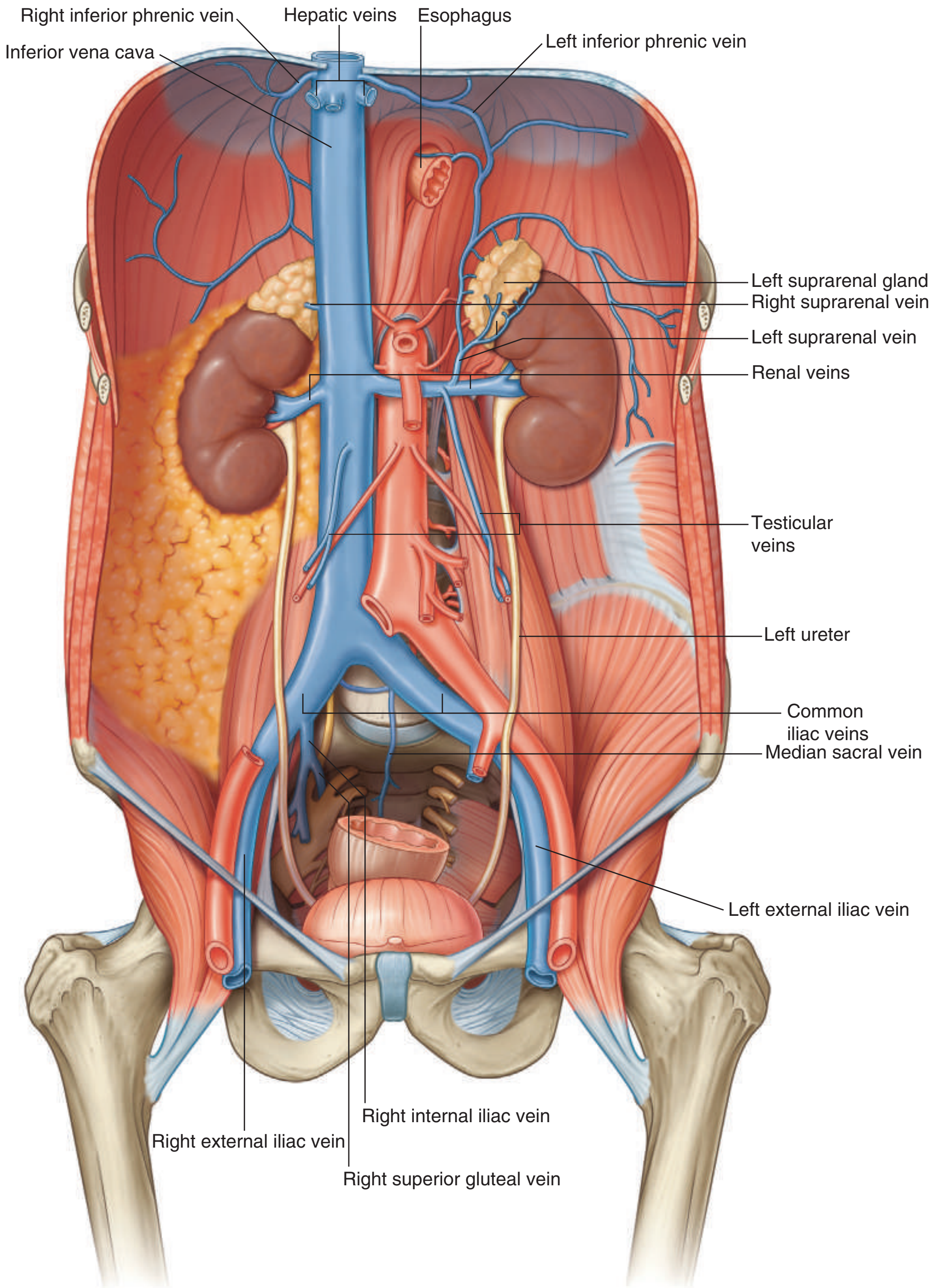

Right inferior phrenic vein
Hepatic veins
Esophagus
Inferior vena cava
Left inferior phrenic vein
Left suprarenal gland
Right suprarenal vein
Left suprarenal vein
Renal veins
Testicular veins
Left ureter
Common iliac veins
Median sacral vein
Left external iliac vein
Right internal iliac vein
Right external iliac vein
Right superior gluteal vein

Plate 13.1 Inferior vena cava and tributaries.

- Hold one of the two kidneys in your hand. Make a vertical incision along its lateral border, and transect the kidney into two parts (Fig. 13.21).
- Open and inspect the inner part of the kidney.
- Identify the outer layer, the renal cortex, and the inner layer, the *renal medulla* (Plate 13.2).

ANATOMY **NOTE**

Realize that the cortex sends extensions into the medulla, the *renal columns.* The renal medulla is composed of *pyramids,* projections of the renal *papillae,* which contain collecting ducts that drain urine into the minor *calyces.* About 10 minor calyces combine to form three major calyces; all major calyces combine to form the *renal pelvis,* located at the hilum of the kidney (Fig. 13.22).

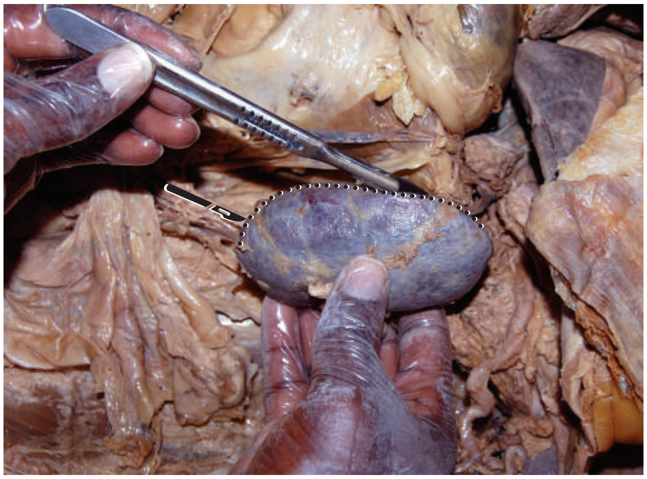


Fig. 13.21 An incision into the kidney along its border allows access to its internal structures.

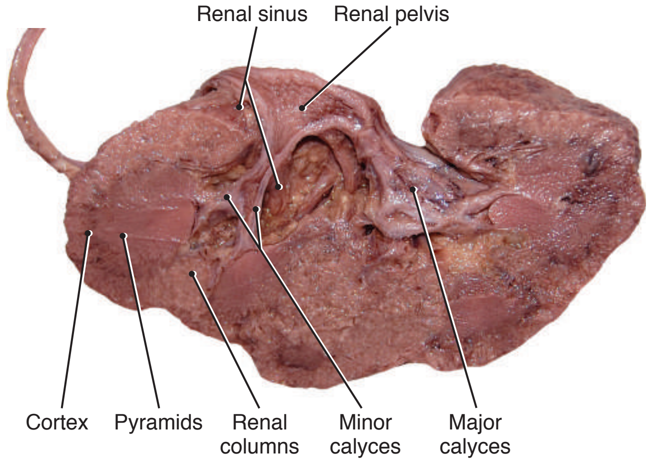

Renal sinus
Renal pelvis
Cortex
Pyramids
Renal columns
Minor calyces
Major calyces

Fig. 13.22 Inside the kidney, note the cortex, medulla, calyces, pyramids, and columns.

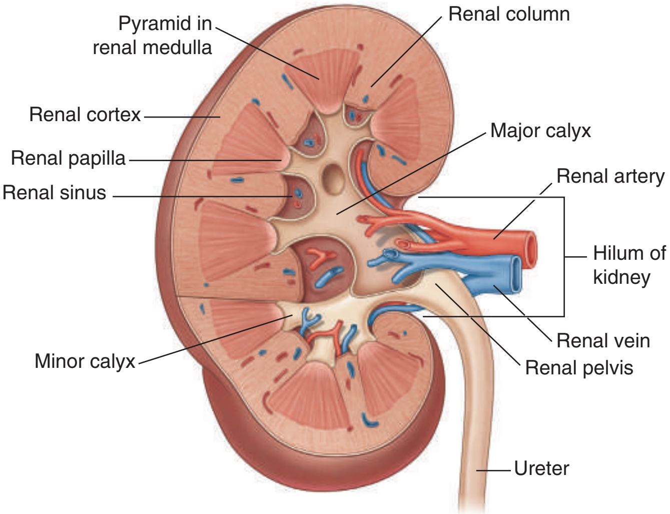

Pyramid in renal medulla
Renal column
Renal cortex
Major calyx
Renal papilla
Renal artery
Renal sinus
Hilum of kidney
Renal vein
Minor calyx
Renal pelvis
Ureter

Plate 13.2 Internal structure of the kidney.

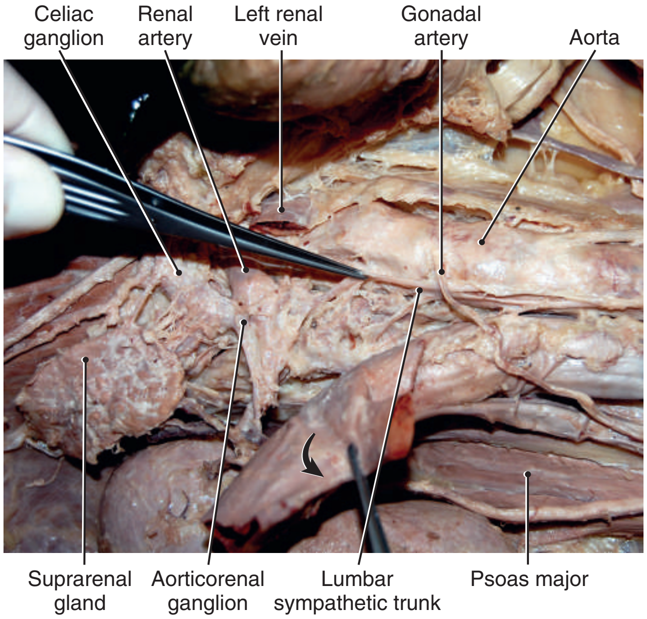
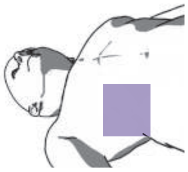

Celiac ganglion
Renal artery
Left renal vein
Gonadal artery
Aorta
Suprarenal gland
Aorticorenal ganglion
Lumbar sympathetic trunk
Psoas major

Fig. 13.23 Right sympathetic trunk between the IVC and abdominal aorta.



- Between the inferior vena cava and the abdominal aorta, at the level of the right renal vein, locate the right sympathetic trunk (Fig. 13.23).
- You also can trace the sympathetic trunk just underneath the IVC, between the psoas major muscle and the vertebral column (Figs. 13.24 and 13.25). The sympathetic trunk contributes lumbar splanchnic nerves to the superior hypogastric plexus (see Fig. 13.24).
- The right and left renal arteries are surrounded by a dense network of neural fibers (see Fig. 13.22). Identify the *aorticorenal ganglion*.

ANATOMY **NOTE**

This ganglion further connects with the celiac ganglion, occupying the area over the celiac trunk (see Fig. 13.22). Preganglionic sympathetic fibers reach the celiac, aorticorenal, and superior mesenteric ganglia by way of the greater, lesser, and least splanchnic nerves, respectively. These fibers synapse in the ganglia, and postganglionic fibers travel along the arteries of the abdomen.

- Lift the kidney upward, and clean out the posterior surface of the renal hilum (Fig. 13.26).
- Identify the psoas major muscle, and remove the fascia over the right crus of the diaphragm and psoas major muscle (Fig. 13.27).

NERVES

- At the opening of the IVC, look for the inferior phrenic artery, and trace it to its origin from the aorta.

DISSECTION **TIP**

In some cases, the inferior phrenic artery originates from the celiac trunk.

- **Next to the inferior phrenic artery, dissect out the continuation of the phrenic nerve into the abdominal cavity (see Fig. 13.27). The phrenic nerve accompanies the inferior phrenic artery and is related to the phrenic ganglion.**

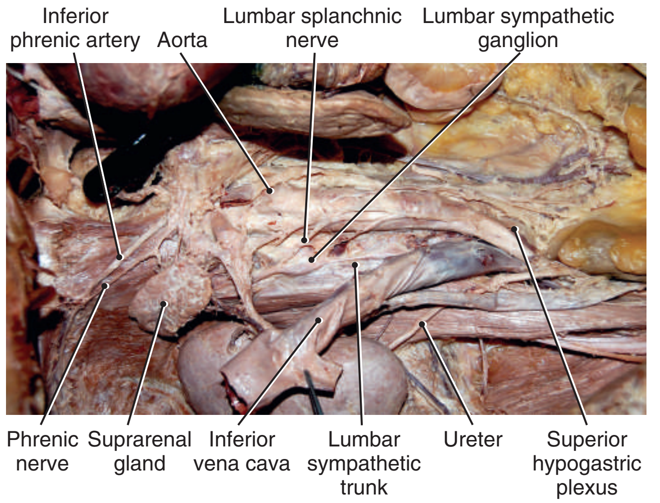
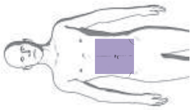

Inferior phrenic artery
Aorta
Lumbar splanchnic nerve
Lumbar sympathetic ganglion
Phrenic nerve
Suprarenal gland
Inferior vena cava
Lumbar sympathetic trunk
Ureter
Superior hypogastric plexus

Fig. 13.24 The sympathetic trunk is shown giving rise to lumbar splanchnic nerves that contribute to the pancreatic and superior hypogastric plexuses.



- **Lift the kidney upward, and look between the superomedial border of the psoas major and the right crus of the diaphragm for the greater, lesser, and least splanchnic nerves (Figs. 13.28 and 13.29).**

DISSECTION **TIP**

You also may pull the celiac ganglion upward and look for the greater splanchnic nerve underneath.

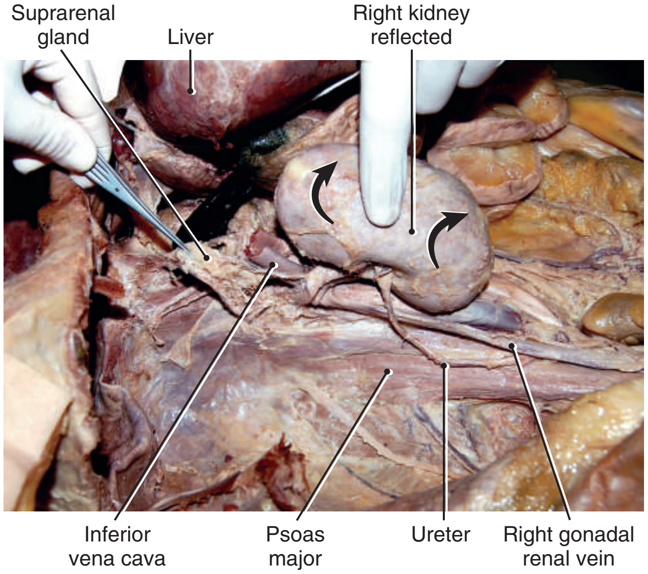
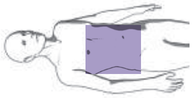

Suprarenal gland
Liver
Right kidney reflected
Inferior vena cava
Psoas major
Ureter
Right gonadal renal vein

Fig. 13.26 Right kidney lifted upward to clean out posterior surface of renal hilum.



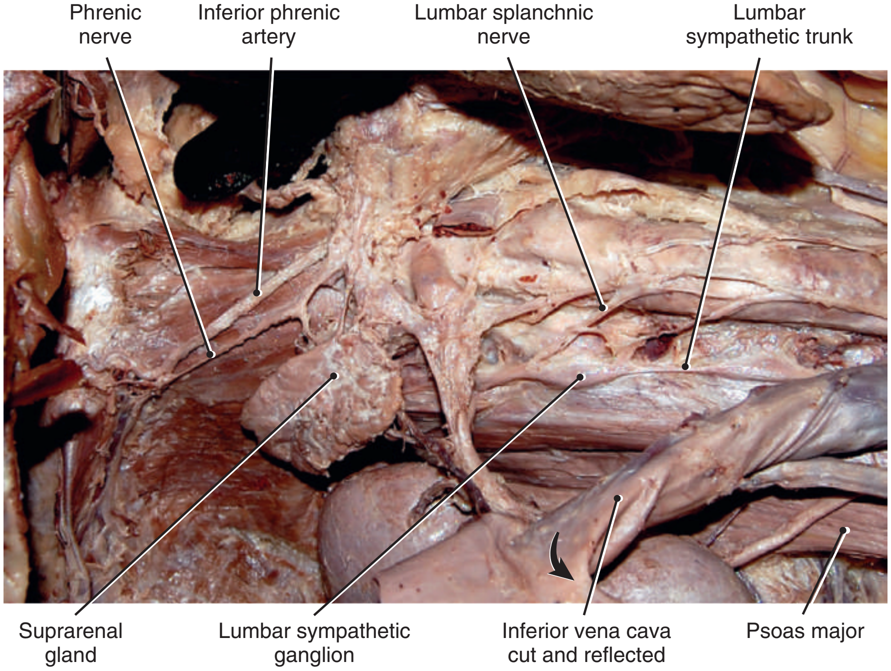
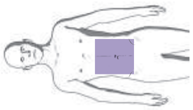

Phrenic nerve
Inferior phrenic artery
Lumbar splanchnic nerve
Lumbar sympathetic trunk
Suprarenal gland
Lumbar sympathetic ganglion
Inferior vena cava cut and reflected
Psoas major

Fig. 13.25 Sympathetic trunk courses underneath the IVC between psoas major muscle and vertebral column.



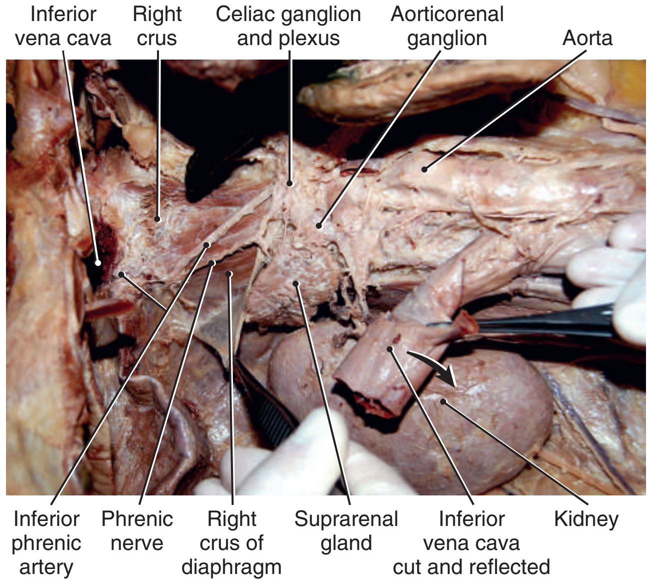
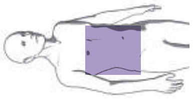

Inferior vena cava
Right crus
Celiac ganglion and plexus
Aorticorenal ganglion
Aorta
Inferior phrenic artery
Phrenic nerve
Right crus of diaphragm
Suprarenal gland
Inferior vena cava cut and reflected
Kidney

Fig. 13.27 Fascia removed over right crus of diaphragm and psoas major muscle.



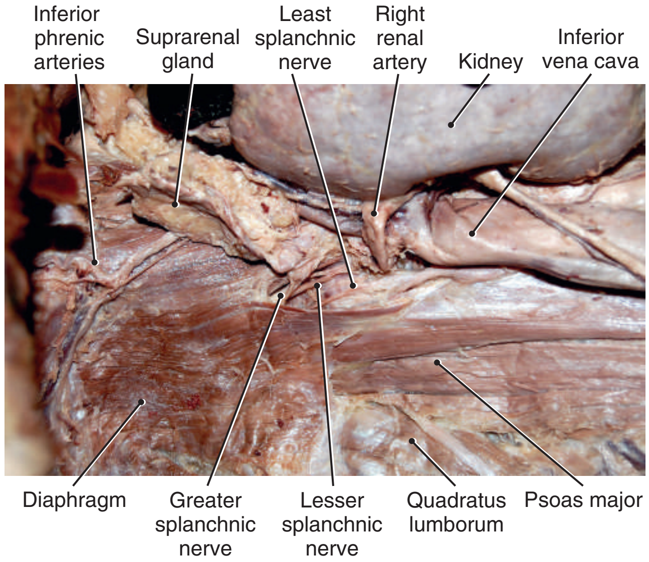
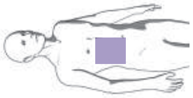

Inferior phrenic arteries
Suprarenal gland
Least splanchnic nerve
Right renal artery
Kidney
Inferior vena cava
Diaphragm
Greater splanchnic nerve
Lesser splanchnic nerve
Quadratus lumborum
Psoas major

Fig. 13.29 Greater, lesser, and least splanchnic nerves coursing between the superomedial border of the psoas major muscle and the right crus of diaphragm.



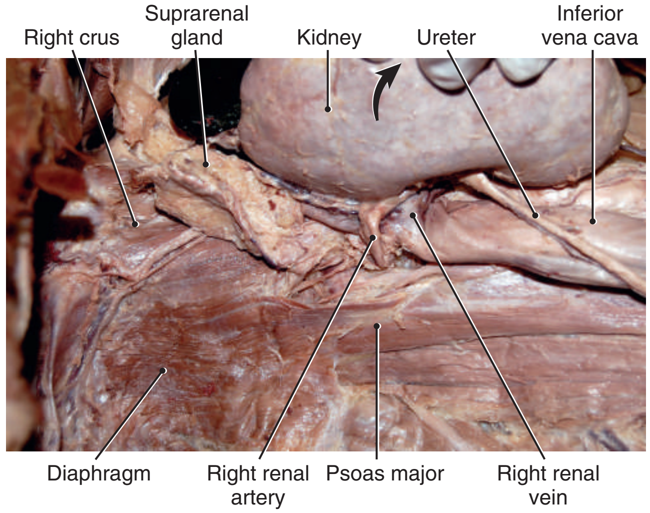
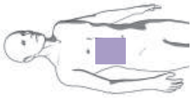

Right crus
Suprarenal gland
Kidney
Ureter
Inferior vena cava
Diaphragm
Right renal artery
Psoas major
Right renal vein

Fig. 13.28 Appreciate underlying structures with kidney lifted.



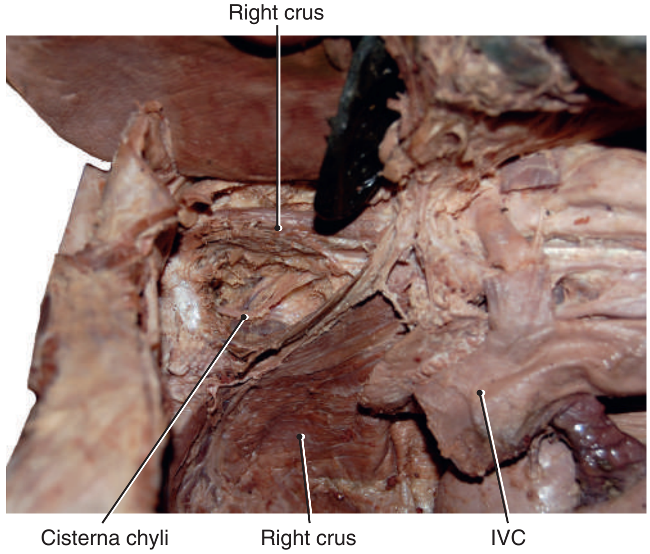
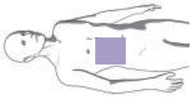

Right crus
Cisterna chyli
Right crus
IVC

Fig. 13.30 Vertical incision at right crus of diaphragm exposes cisterna chyli. *IVC,* Inferior vena cava.



- Trace these nerves to their terminations at the celiac ganglion (for the greater), aorticorenal ganglion (for the lesser), and superior mesenteric ganglion (for the least).
- Between the abdominal aorta and the IVC and at the left side of the aorta, identify the right and left lumbar lymph trunks, respectively.
- These lymph trunks eventually join the intestinal lymph trunk and form the *cisterna chyli*. Make a vertical incision at the right crus of the diaphragm, and expose the cisterna chyli (Fig. 13.30).
- Open up the thoracic cavity and identify the anterior and posterior vagal trunks around the lower part of the esophagus.
- Place slight traction on the anterior vagal trunk, which originates primarily from the left vagus nerve, and look anterior to the cardioesophageal junction for a mobile structure.
- Locate the anterior vagal trunk and expose its branches.
- Similarly, place slight traction on the posterior vagal trunk in the thorax (primarily right vagus nerve) and find the medial side of the *esophageal hiatus,* or the

right side of the esophagus, for identification of the posterior vagal trunk (Fig. 13.31).

INSPECTION OF POSTERIOR ABDOMINAL STRUCTURES

- Observe the thoracic and abdominal surfaces of the diaphragm. Note the central tendinous portion of the diaphragm, the *central tendon*.
- Lateral to the esophagus, identify the *right and left crura*, the two muscular extensions of the diaphragm arising from the central tendon to insert onto the 2nd or 3rd lumbar (L2 or L3) vertebrae.
- Fibers from the right and left crura intermix to encircle the esophagus as it passes through the diaphragm. Just superior to the celiac trunk, the right and left crura are united by a midline tendon, the *median arcuate ligament.*
- Laterally, the diaphragm attaches to the ribs and inferolaterally it attaches to the psoas major forming a thickened connective tissue band, the *medial arcuate ligament.*
- More laterally, the diaphragm arches over the quadratus lumborum to attach to the 12th rib, forming another thickened connective tissue band over the quadratus lumborum, the *lateral arcuate ligament* (see Fig. 13.31).

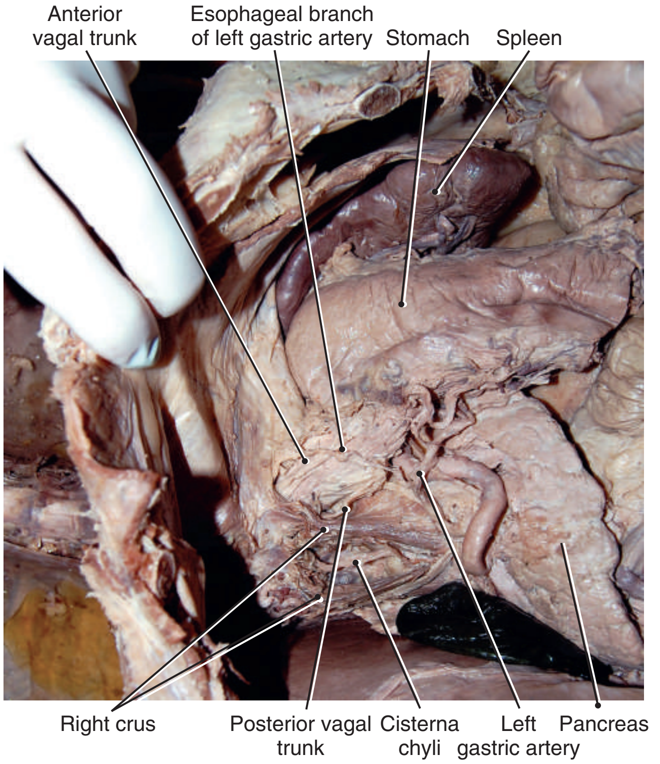
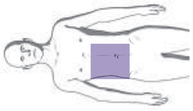

Anterior vagal trunk
Esophageal branch of left gastric artery
Stomach
Spleen
Right crus
Posterior vagal trunk
Cisterna chyli
Left gastric artery
Pancreas

Fig. 13.31 Thoracic cavity opened and anterior and posterior vagal trunks around lower esophagus used to locate anterior and posterior trunks in the abdominal cavity.



- Remove any remaining fat inferior to the right and left kidneys to expose the lumbar plexus and the underlying muscles (Fig. 13.32).
- Identify the psoas major muscle and, lateral to it, the quadratus lumborum muscle.

DISSECTION **TIP**

In about 50% of cadaveric donors, the psoas minor muscle is evident on the anterior surface of the psoas major.

- Inferior to the quadratus lumborum, identify the iliacus muscle, which lies in the iliac fossa. Palpate the 12th rib and at its inferior border, expose the *subcostal nerve.*
- On the lateral side of the psoas major muscle, identify the *genitofemoral nerve* as it travels on its anterior surface.
- A few centimeters below the origin of the *iliohypogastric nerve*, identify the *ilioinguinal nerve*, which travels from the lateral side of the psoas major muscle toward the anterior superior iliac spine.
- At the lateral side of the distal end of the psoas major muscle in the abdominal cavity, identify the *femoral nerve* and, lateral to it, the much smaller *lateral femoral cutaneous nerve.*
- Medial to the psoas major muscle, place a probe or a pair of scissors and separate the psoas major

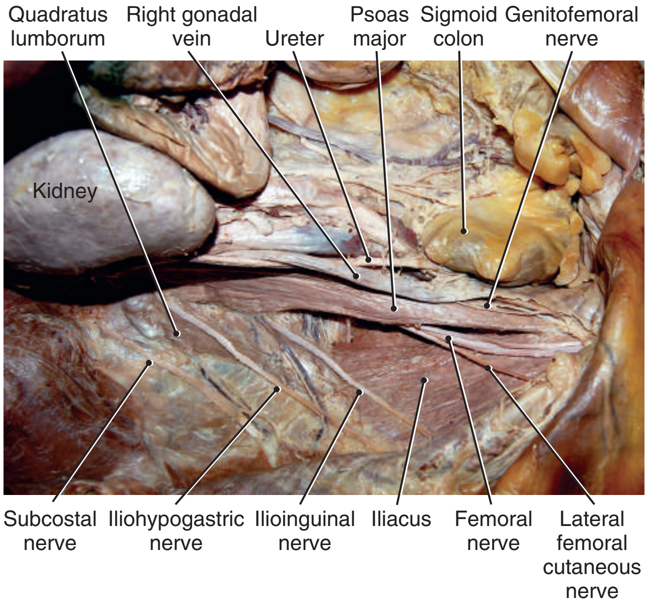
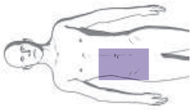

Quadratus lumborum
Right gonadal vein
Ureter
Psoas major
Sigmoid colon
Genitofemoral nerve
Kidney
Subcostal nerve
Iliohypogastric nerve
Ilioinguinal nerve
Iliacus
Femoral nerve
Lateral femoral cutaneous nerve

Fig. 13.32 Removal of fat inferior to right and left kidneys exposes branches of the lumbar plexus and underlying muscles.



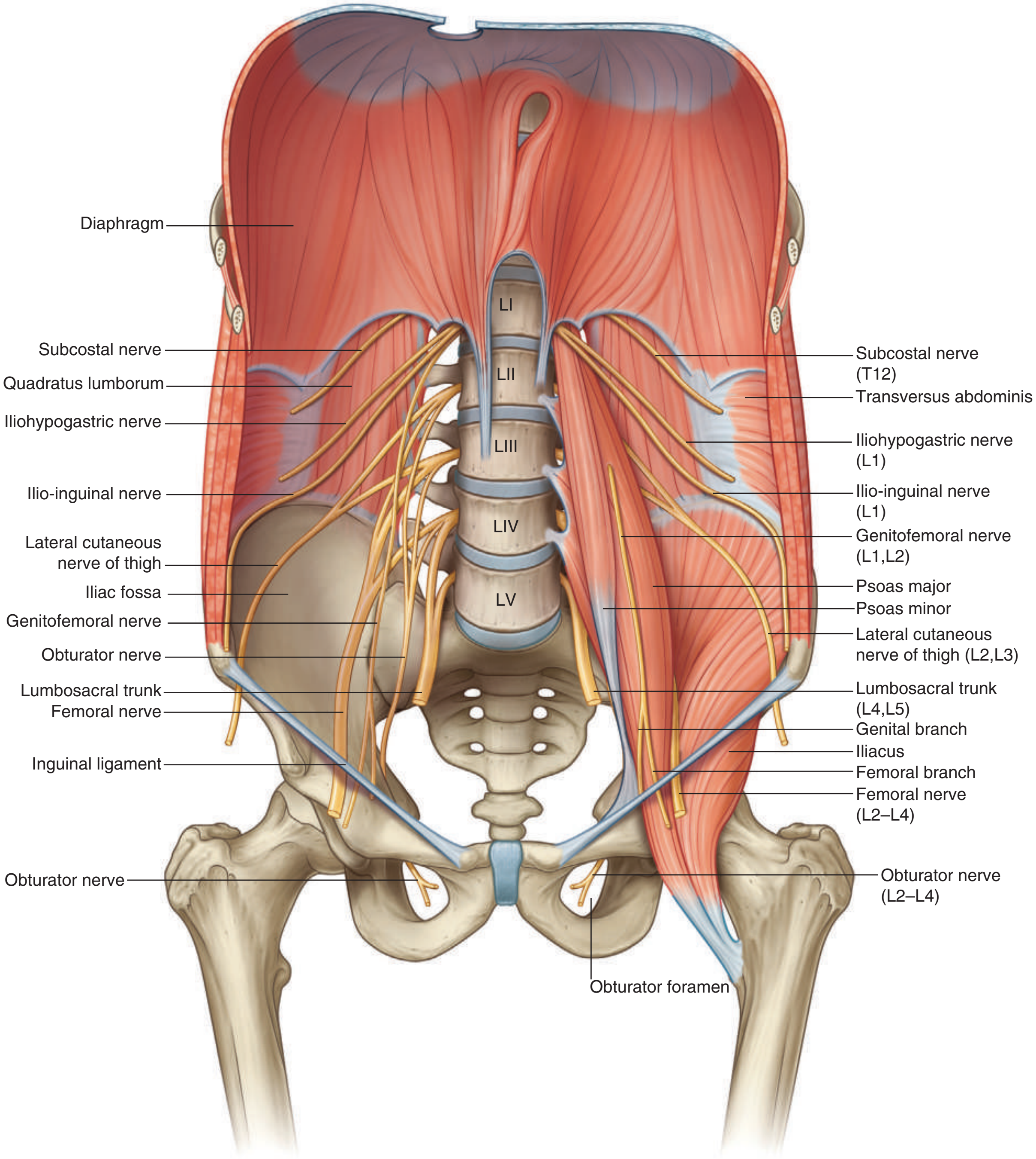
from the adjacent external iliac artery and vein (Fig. 13.33).

- Deep and medial to the psoas major muscle, identify the *obturator nerve* (Fig. 13.34).
- Once all branches of the lumbar plexus are identified, on one side of the cadaver, carefully remove the psoas major muscle in a piecemeal fashion, and expose the origin of the nerves of the lumbar plexus (Fig. 13.35 and Plate 13.3).

DISSECTION **TIP**

In most cadavers, the lumbar plexus exhibits great variation.

- The most common variation is that the ilioinguinal and iliohypogastric nerves fuse and split into their terminal branches just proximal to the *anterior superior iliac spine.*
- Similarly, the subcostal and iliohypogastric nerves can be fused and split more distally.



Diaphragm
Subcostal nerve
Quadratus lumborum
Iliohypogastric nerve
Ilio-inguinal nerve
Lateral cutaneous nerve of thigh
Iliac fossa
Genitofemoral nerve
Obturator nerve
Lumbosacral trunk
Femoral nerve
Inguinal ligament
Obturator nerve
LI
LII
LIII
LIV
LV
Subcostal nerve (T12)
Transversus abdominis
Iliohypogastric nerve (L1)
Ilio-inguinal nerve (L1)
Genitofemoral nerve (L1,L2)
Psoas major
Psoas minor
Lateral cutaneous nerve of thigh (L2,L3)
Lumbosacral trunk (L4,L5)
Genital branch
Iliacus
Femoral branch
Femoral nerve (L2–L4)
Obturator nerve (L2–L4)
Obturator foramen

Lumbar plexus

Plate 13.3 The lumbar plexus.

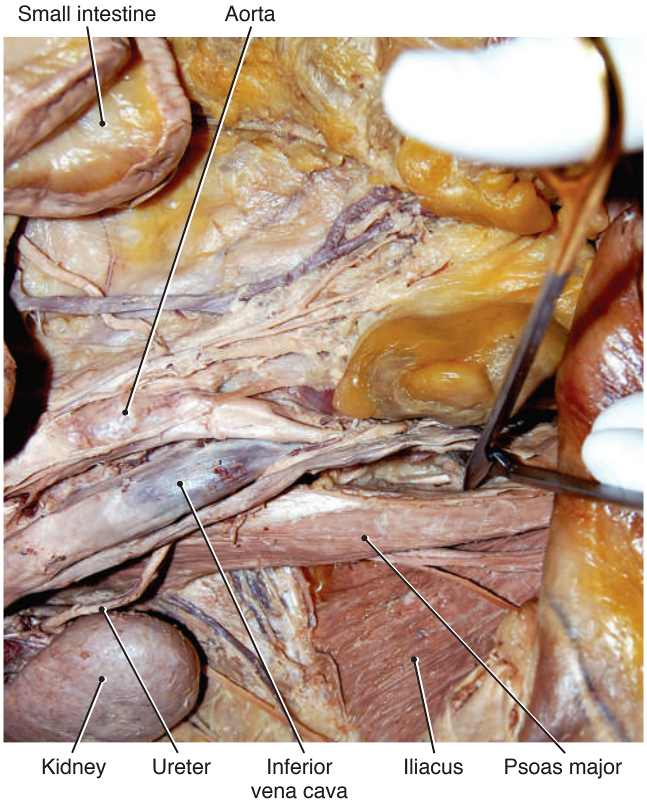
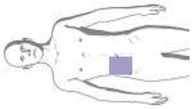

Small intestine
Aorta
Kidney
Ureter
Inferior vena cava
Iliacus
Psoas major

Fig. 13.33 Psoas major muscle separated from adjacent external iliac artery and vein.



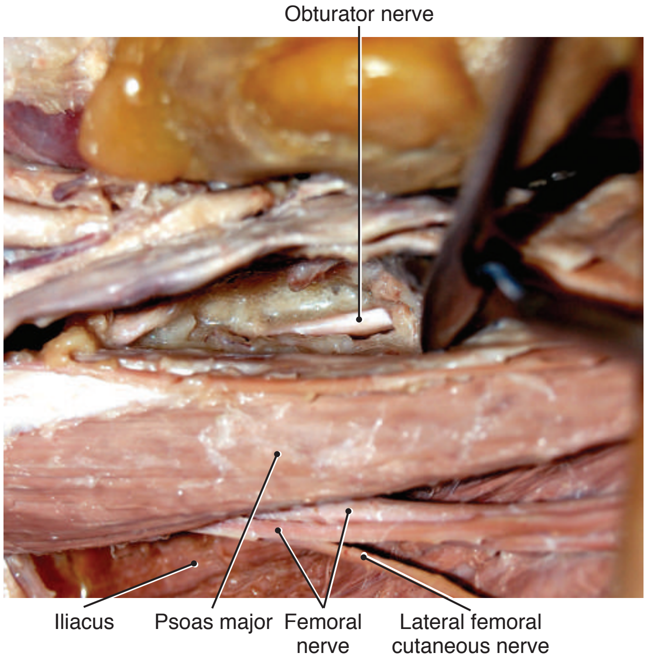
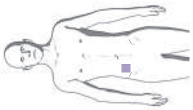

Obturator nerve
Iliacus
Psoas major
Femoral nerve
Lateral femoral cutaneous nerve

Fig. 13.34 Obturator nerve lies deep and medial to the psoas major muscle.



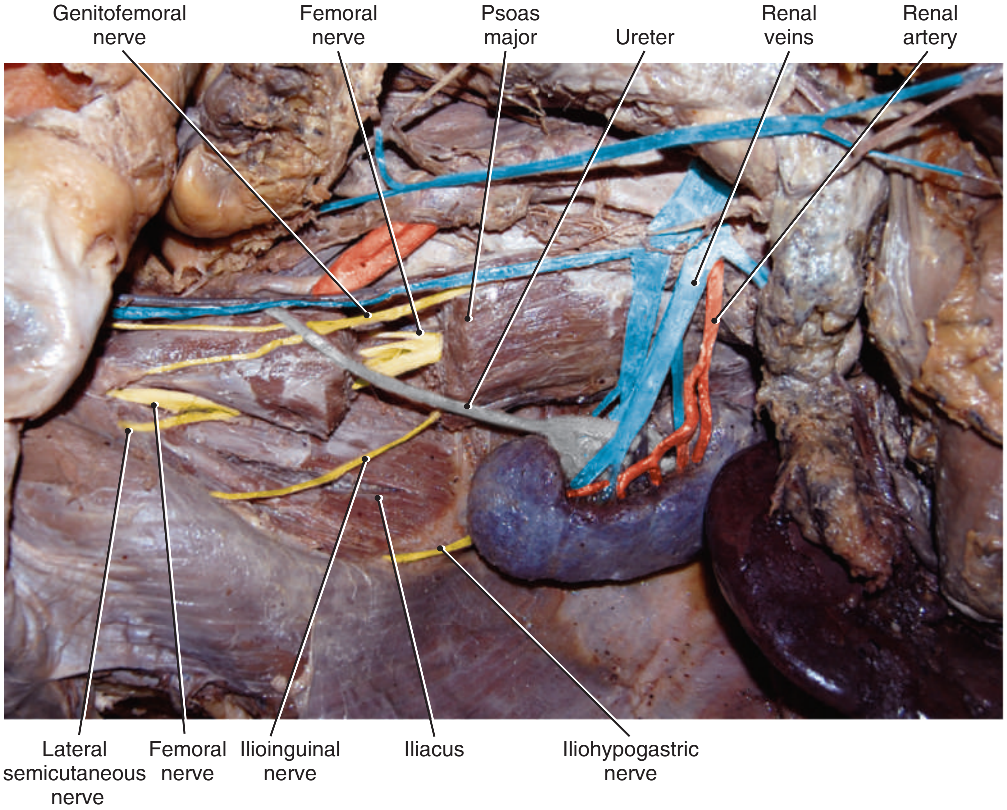

Genitofemoral nerve
Femoral nerve
Psoas major
Ureter
Renal veins
Renal artery
Lateral semicutaneous nerve
Femoral nerve
Ilioinguinal nerve
Iliacus
Iliohypogastric nerve

Fig. 13.35 Psoas major muscle removed exposing origin of lumbar plexus nerves.

LABORATORY IDENTIFICATION CHECKLIST

NERVES/CONNECTIVE TISSUE

- ☐ Iliohypogastric
- ☐ Ilioinguinal
- ☐ Genitofemoral
- ☐ Lateral femoral cutaneous
- ☐ Femoral
- ☐ Obturator
- ☐ Accessory obturator (variation)
- ☐ Lumbosacral trunk
- ☐ Sympathetic trunk
  - ☐ Gray/white rami communicantes
  - ☐ Sympathetic ganglion
  - ☐ Lumbar splanchnic
- ☐ Celiac ganglia
- ☐ Celiac plexus
- ☐ Suprarenal plexus
- ☐ Aorticorenal ganglion
- ☐ Superior mesenteric plexus
- ☐ Intermesenteric (aortic) plexus

ARTERIES

- ☐ Right and left inferior phrenic
- ☐ Superior suprarenal
- ☐ Middle suprarenal
- ☐ Inferior suprarenal
- ☐ Renal
- ☐ Gonadal
- ☐ Lumbar
- ☐ Subcostal
- ☐ Iliolumbar

VEINS

- ☐ Inferior vena cava (IVC)
- ☐ Inferior phrenic
- ☐ Suprarenal
- ☐ Renal
- ☐ Gonadal
- ☐ Lumbar
- ☐ Iliolumbar

LYMPH

- ☐ Cisterna chyli

MUSCLES/CONNECTIVE TISSUE

- ☐ Right crus
  - ☐ Ligament of Treitz
- ☐ Left crus
- ☐ Psoas major
- ☐ Psoas minor
- ☐ Quadratus lumborum
- ☐ Transversus abdominis
- ☐ Median arcuate ligament
- ☐ Medial arcuate ligament
- ☐ Lateral arcuate ligament

ORGANS

- ☐ Kidney
- ☐ Ureter
- ☐ Suprarenal gland

BONES

- ☐ Coxal, right and left
- ☐ Sacrum
- ☐ Vertebrae
  - ☐ 12th thoracic (T12)
  - ☐ 1st to 5th lumbar: (L1-L5)

CLINICAL APPLICATIONS

PERITONEAL ASPIRATION/LAVAGE

Gray's Anatomy for Students: 135, 136
Netter: 252, 254

Clinical Application

Procedure introduces a trocar to withdraw fluid or to introduce saline into the peritoneal cavity for irrigation.

Anatomic Landmarks (Figs. V.1 and V.2)

- Infraumbilical region
- Skin
- Subcutaneous tissue
- Linea alba/rectus abdominis muscle
- Transversalis fascia
- Extraperitoneal fat
- Parietal peritoneum
- Umbilicus
- Anterior superior iliac spine (ASIS)

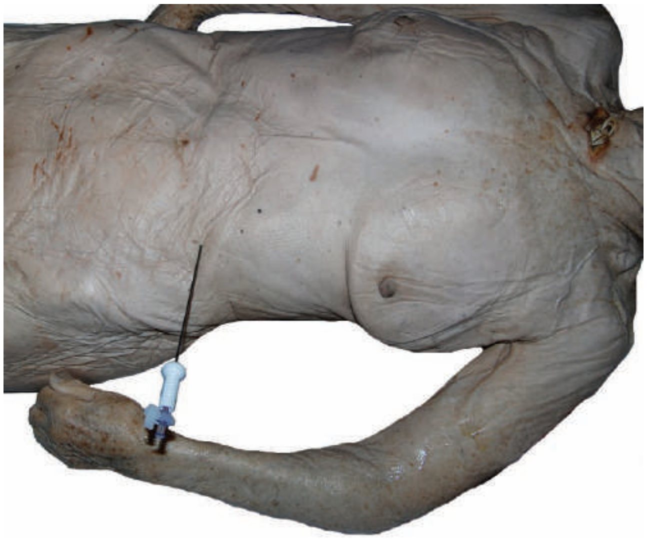


Fig. V.1

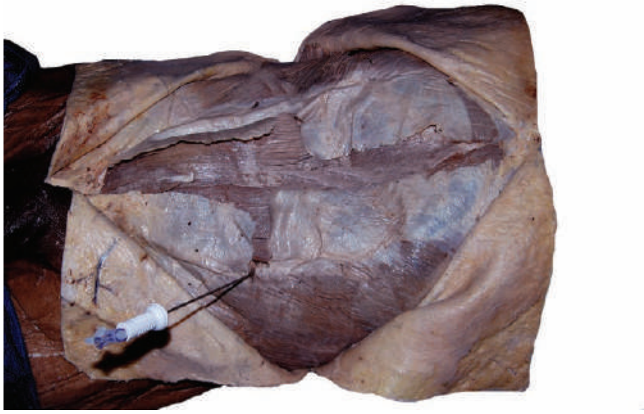


Fig. V.2

PARACENTESIS

Gray's Anatomy for Students: 135, 136
Netter: 252, 254

Clinical Application

Procedure withdraws fluid (e.g., ascites) from the peritoneal cavity.

Anatomic Landmarks

Infraumbilical Region
- Skin
- Subcutaneous tissue
- Linea alba
- Median umbilical fold/ligament
- Medial umbilical fold/ligament
- Transversalis fascia
- Extraperitoneal fat/space
- Peritoneal sac

About 5 cm Superior to ASIS
Layers traversed:
- Skin (lateral to rectus)
- Subcutaneous tissue
- External abdominal oblique aponeurosis
- Internal abdominal oblique muscle
- Transversus abdominis muscle
- Transversalis fascia
- Extraperitoneal fat/space
- Peritoneum

PUDENDAL NERVE BLOCK

Gray's Anatomy for Students: 267
Netter: 395

Clinical Application

Procedure places a bolus of local anesthetic into the pudendal canal, anesthetizing the pudendal nerve and its branches.

Anatomic Landmarks (Figs. V.3 and V.4)

- Vaginal introitus
- Lateral vagina wall and mucosa
- Vaginal mucosa
- Ischial spine

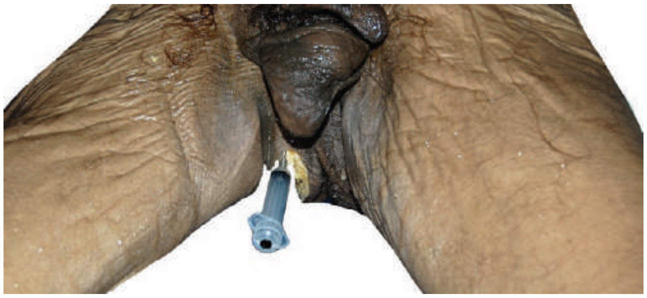


Fig. V.3

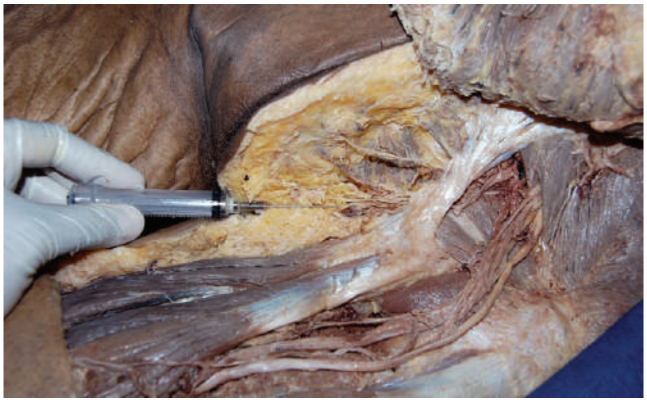


Fig. V.4

- Coccygeus
- Sacrospinous ligament (resistance)
- Pudendal canal (Alcock's canal)
- Pudendal nerve
- Internal pudendal artery
- Internal pudendal vein

HERNIATIONS AND OTHER PATHOLOGIES

The following cadavers exhibited marked herniations and other examples of abdominal and vascular abnormalities, including life-threatening aortic aneurysm.

- Umbilical hernia (Fig. V.5)
- Umbilical hernia and an indirect inguinal hernia (Figs. V.6 and V.7)
- Massive malignancies in the abdominal cavity and the liver (Fig. V.8)
- Multiple malignant nodules in a sagittal section of the liver (Fig. V.9)
- Example of hepatomegaly (Fig. V.10)
- Dissected liver with evident hepatic arteries and veins (Fig. V.11)
- Example of splenomegaly (Fig. V.12)
- Examples of kidneys with cysts (Figs. V.13, V.14, and V.15)
- Abdominal aortic aneurysm; large Gore-tex tube placed at site is visible (Fig. V.16)
- Large abdominal aortic aneurysm (Fig. V.17)

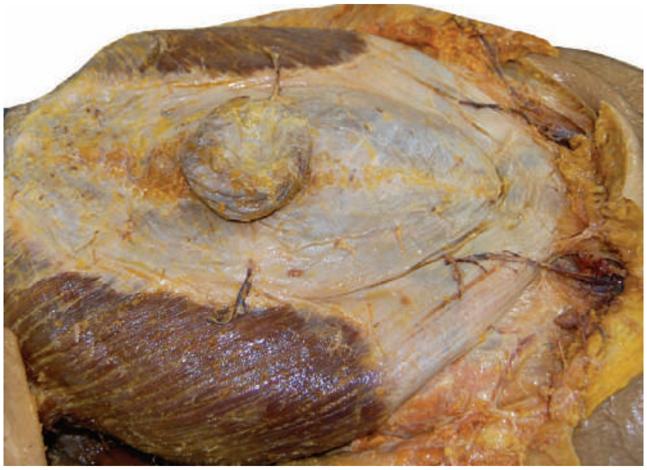


Fig. V.5

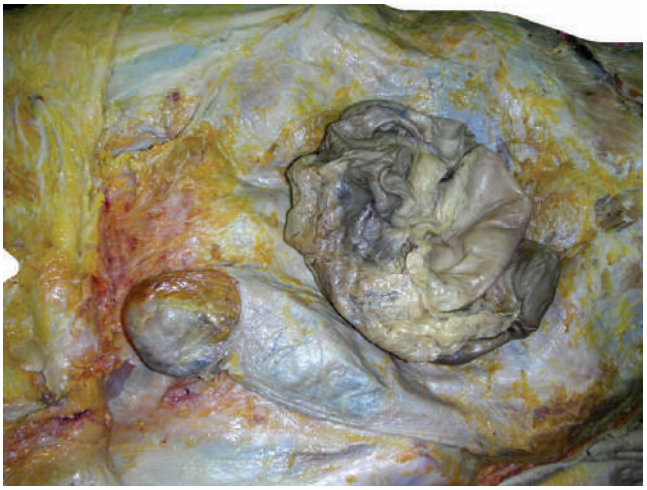


Fig. V.6

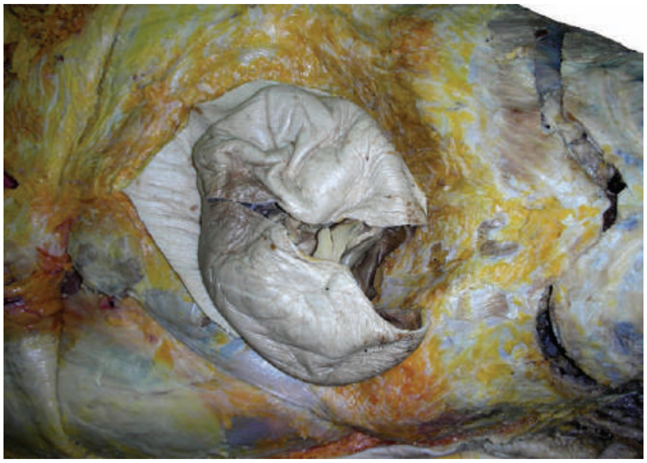


Fig. V.7

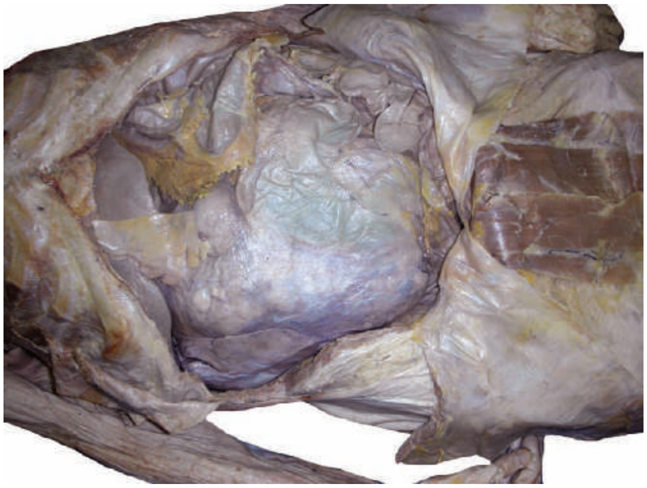


Fig. V.8

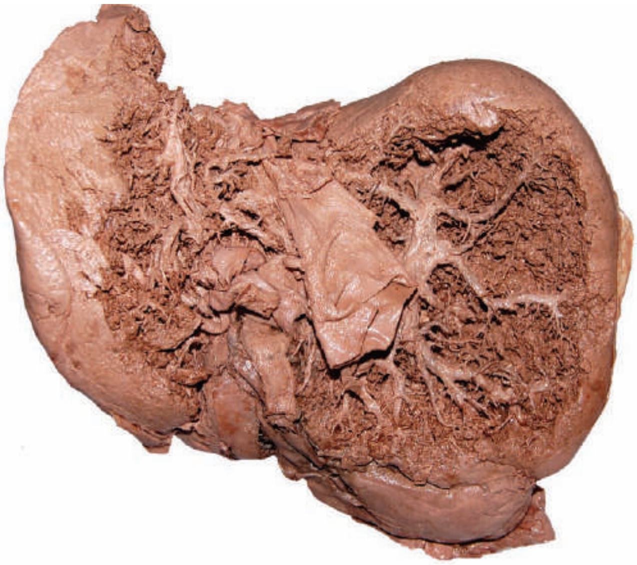


Fig. V.11

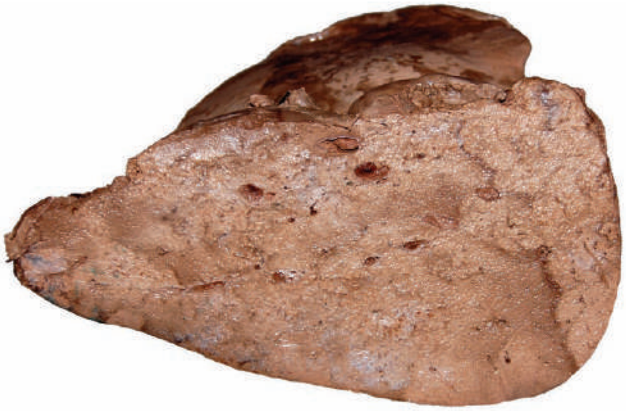


Fig. V.9

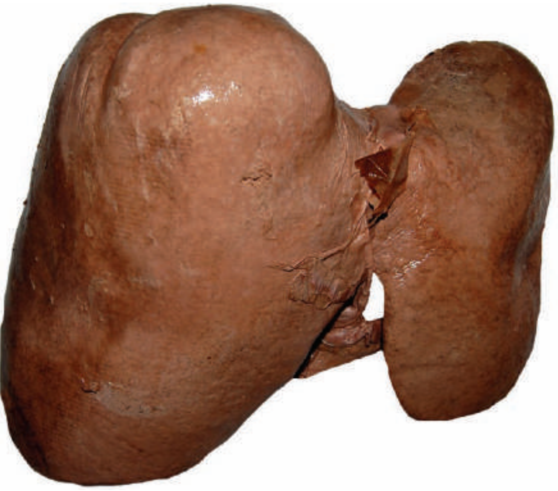


Fig. V.10

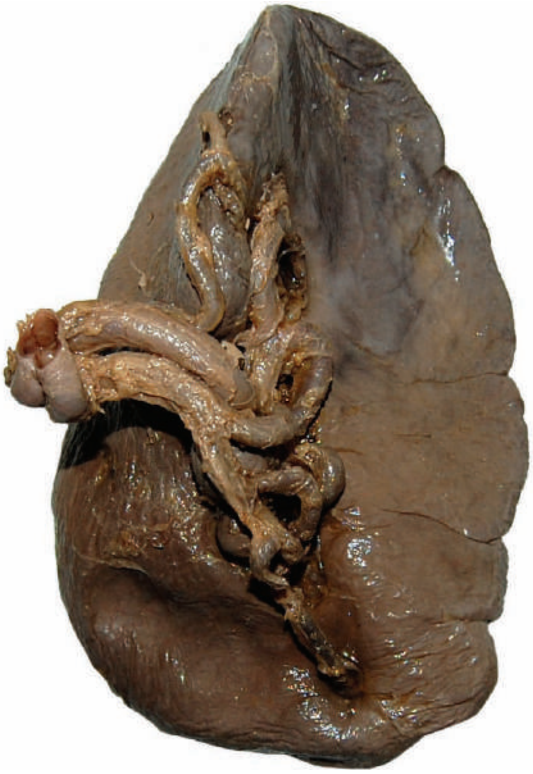


Fig. V.12

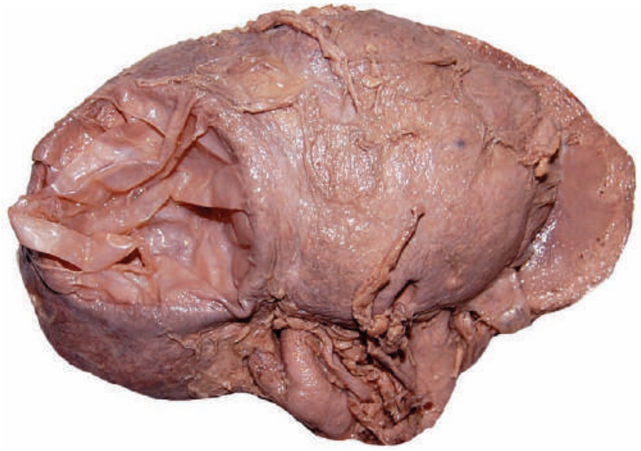


Fig. V.13

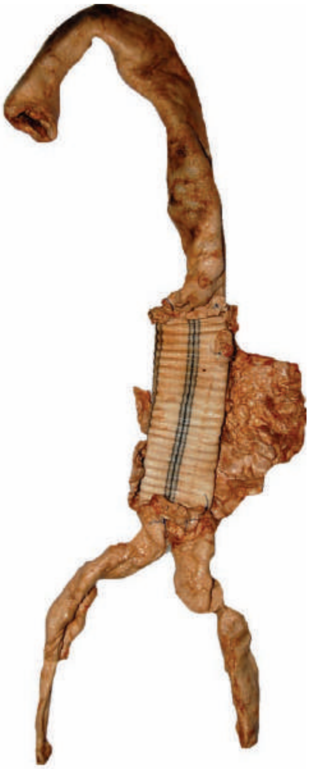


Fig. V.16

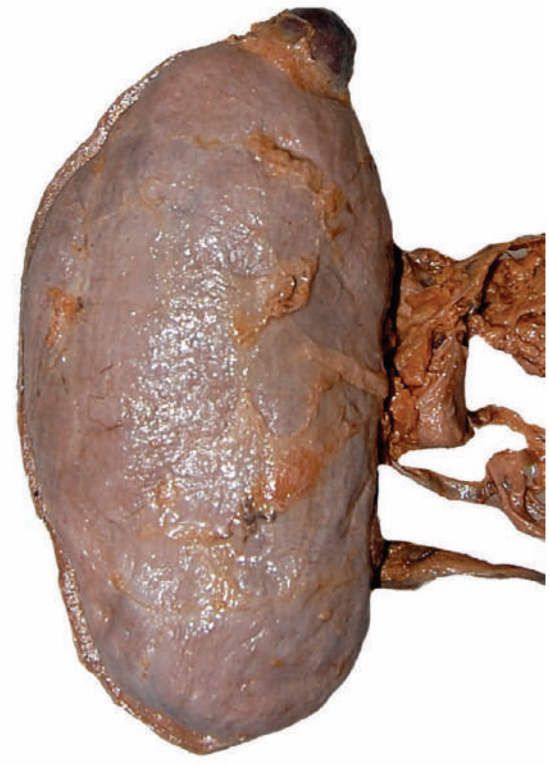


Fig. V.14

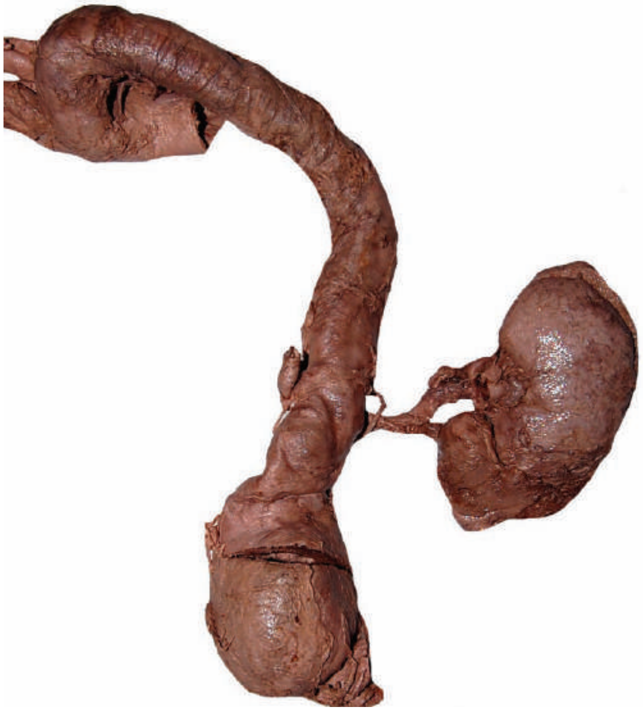


Fig. V.15

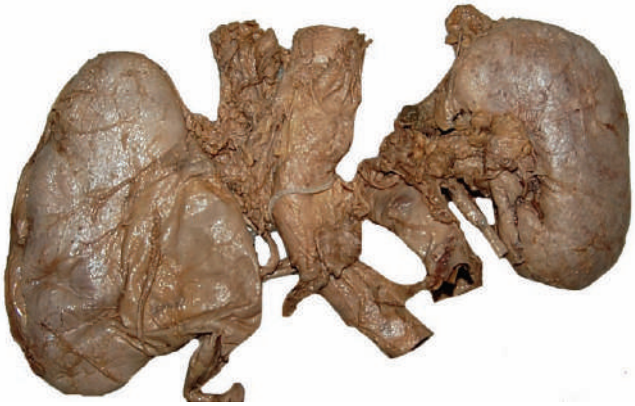


Fig. V.17

CHAPTER 14 PELVIS

ATLAS REFERENCES

Netter: 333–357, 366, 369, 380–385, 388, 390–392
McMinn: 261–275
Gray's Atlas: 212–254, 264–265

Several techniques are used for dissection of the pelvis. This chapter describes the traditional midline hemipelvectomy.

MIDLINE HEMIPELVECTOMY (MALE)

- **Identify the rectosigmoid junction and expose the rectum (Fig. 14.1). Posterior to the pubic symphysis, palpate the urinary bladder.**
- **With a probe or scissors, dissect out and reflect the peritoneum from the posterior surface of the urinary bladder (Figs. 14.2 and 14.3). Notice the median umbilical ligament connecting to the urinary bladder (urachus).**

ANATOMY **NOTE**

The adipose tissue between the posterior surface of the urinary bladder and the peritoneum is termed *preperitoneal fat.*

- **Place your fingertips, using blunt dissection, between the urinary bladder and the pubic symphysis into the retropubic space of Retzius (Fig. 14.4).**
- **Pull on the fascia attached to the lateral sides of the median umbilical ligament and at the superior part of the urinary bladder, the *vesicoumbilical fascia,* and reflect it posteriorly. With this maneuver, observe the expansion of the retropubic space of Retzius.**
- **Mobilize the rectum and the bladder. With a saw, cut the pubic symphysis vertically 2 to 3 cm lateral to the midline (Fig. 14.5).**
- **Mobilize the rectum laterally, and with a scalpel, extend the incision from the pubic symphysis backward toward the sacrum and pelvis (Fig. 14.6). Cut the peritoneum, urinary bladder, aorta, and all soft tissues.**
- **With a scalpel, make a second horizontal incision starting from the aorta, at the level of the kidneys,**

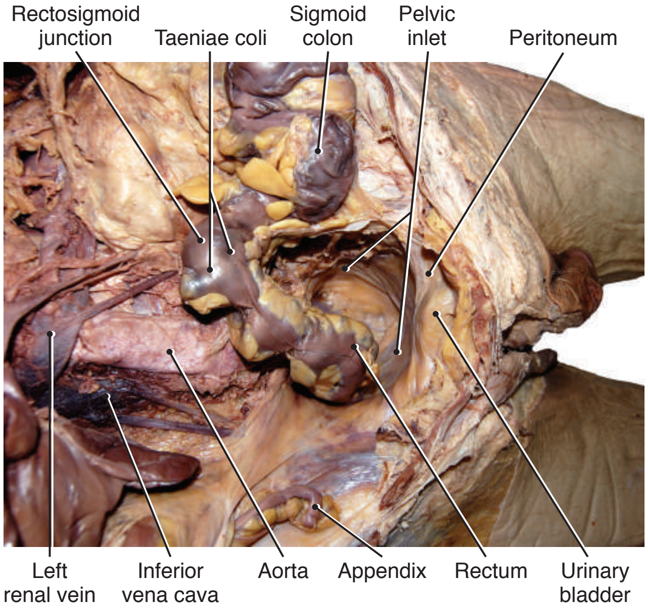
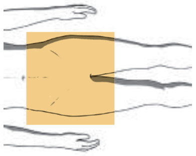
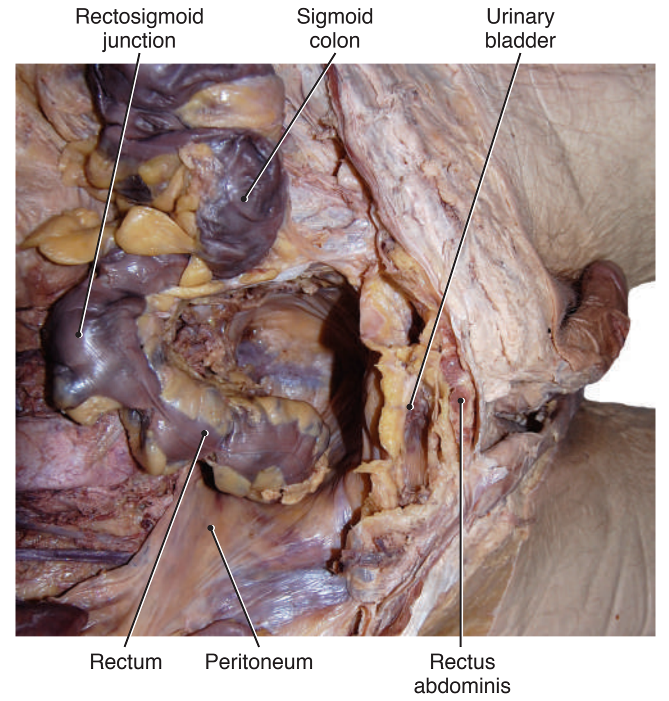


Fig. 14.1 Identification of rectosigmoid junction and exposure of rectum.




Rectosigmoid junction
Sigmoid colon
Urinary bladder
Rectum
Peritoneum
Rectus abdominis

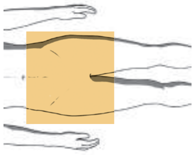


Fig. 14.2 Urinary bladder posterior to pubic symphysis.

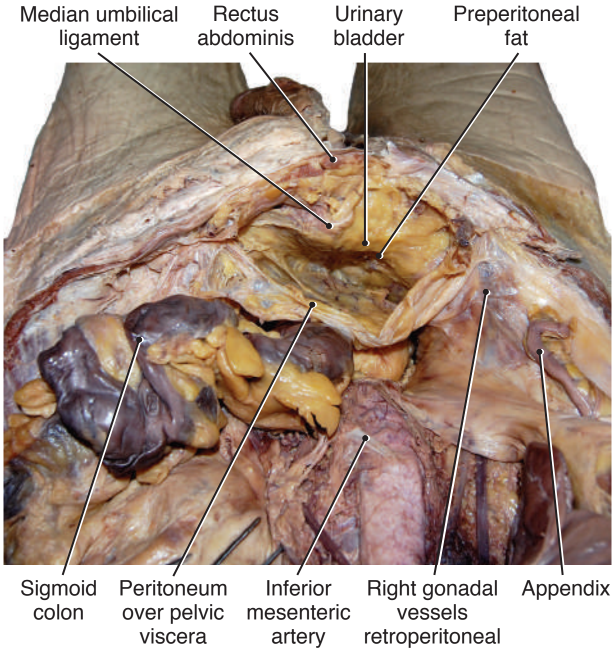

Median umbilical ligament
Rectus abdominis
Urinary bladder
Preperitoneal fat
Sigmoid colon
Peritoneum over pelvic viscera
Inferior mesenteric artery
Right gonadal vessels retroperitoneal
Appendix

Fig. 14.3 Peritoneum reflected from posterior surface of urinary bladder.

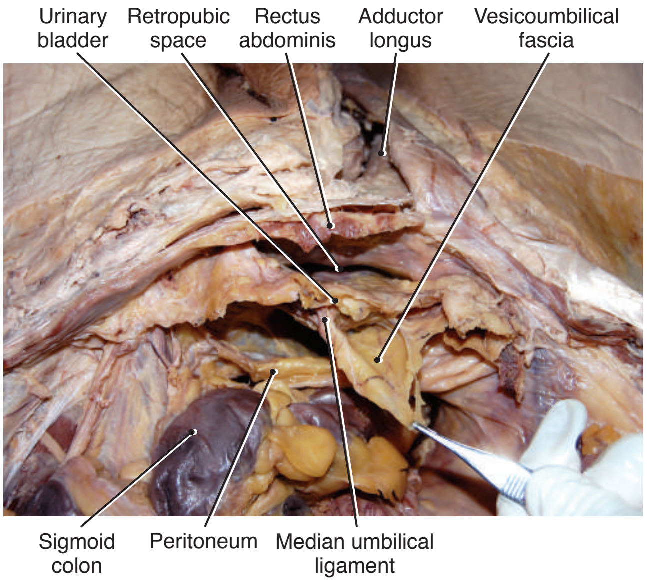

Urinary bladder
Retropubic space
Rectus abdominis
Adductor longus
Vesicoumbilical fascia
Sigmoid colon
Peritoneum
Median umbilical ligament

Fig. 14.4 Blunt dissection between urinary bladder and pubic symphysis into retropubic space.

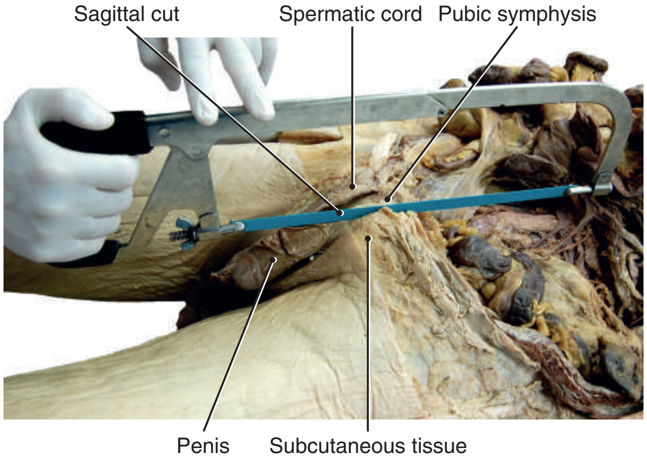

Sagittal cut
Spermatic cord
Pubic symphysis
Penis
Subcutaneous tissue

Fig. 14.5 Pubic symphysis cut vertically about 1 inch (2 to 3 cm) lateral to midline.

and extending laterally along the borders of the iliac crest (Fig. 14.7).

○ With the cadaver on its side, and using a saw, cut the sacrum through its promontory, up through the 4th lumbar vertebra. Saw through the pubic symphysis and make a horizontal incision along the iliac crest (as previously described) and detach this portion of the body (Figs. 14.7 and 14.8).

DISSECTION **TIP**

For the hemipelvectomy, you will need the help of your colleagues to lift and turn the cadaver on its side.

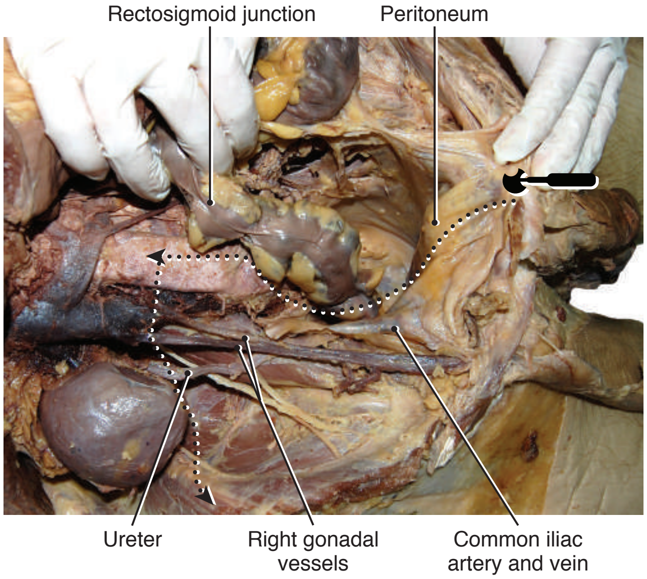
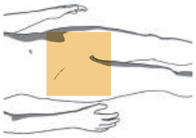

Rectosigmoid junction
Peritoneum
Ureter
Right gonadal vessels
Common iliac artery and vein

Fig. 14.6 Incision extended from pubic symphysis back toward sacrum and pelvis *(dashed line with arrowheads).*



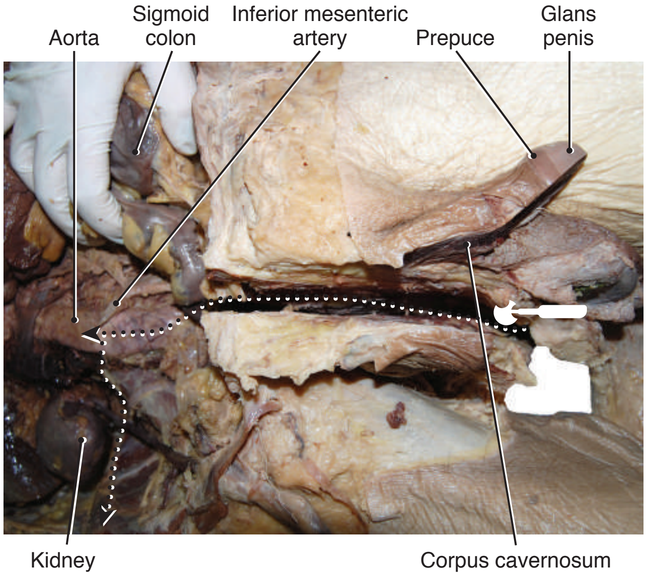
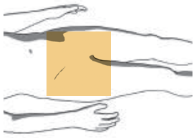

Aorta
Sigmoid colon
Inferior mesenteric artery
Prepuce
Glans penis
Kidney
Corpus cavernosum

Fig. 14.7 Second horizontal incision from aorta extends laterally along iliac crest.



- With scissors, reflect the parietal peritoneum upward (Fig. 14.9).
- Start cleaning the soft tissues and adipose tissue around larger structures (Fig. 14.10).
- Identify the aorta and expose the external iliac artery (Fig. 14.11).

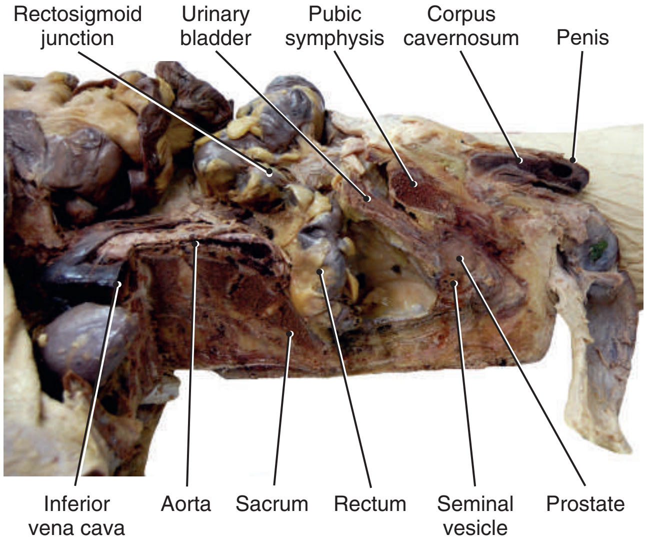

Rectosigmoid junction
Urinary bladder
Pubic symphysis
Corpus cavernosum
Penis
Inferior vena cava
Aorta
Sacrum
Rectum
Seminal vesicle
Prostate

Fig. 14.8 After the cadaver is turned on its side, the saw is passed through the open pubic symphysis. A horizontal cut is made along the iliac crest, and this portion is detached.

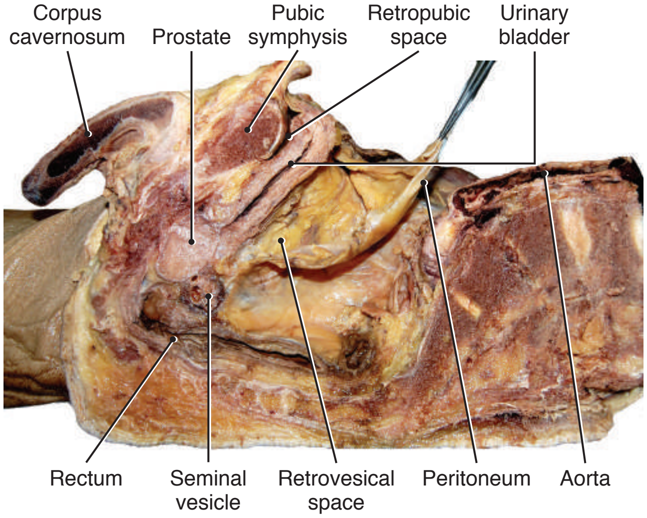
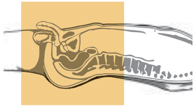

Corpus cavernosum
Prostate
Pubic symphysis
Retropubic space
Urinary bladder
Rectum
Seminal vesicle
Retrovesical space
Peritoneum
Aorta

Fig. 14.9 The peritoneum is reflected upward.



- Trace the ductus deferens and expose it toward the prostate. On surface of the external iliac artery, identify the ureter. Trace and expose the ureter to its entrance to the urinary bladder (Fig. 14.12).
- Inferior to the external iliac artery, expose the external iliac vein. Retract the external iliac vein inferiorly and clean the adipose tissue superior to it. Just inferior to the course of the external iliac vein, identify the obturator nerve and trace it to the obturator foramen (Fig. 14.13).
- Identify the internal iliac artery and expose its anterior and posterior divisions.

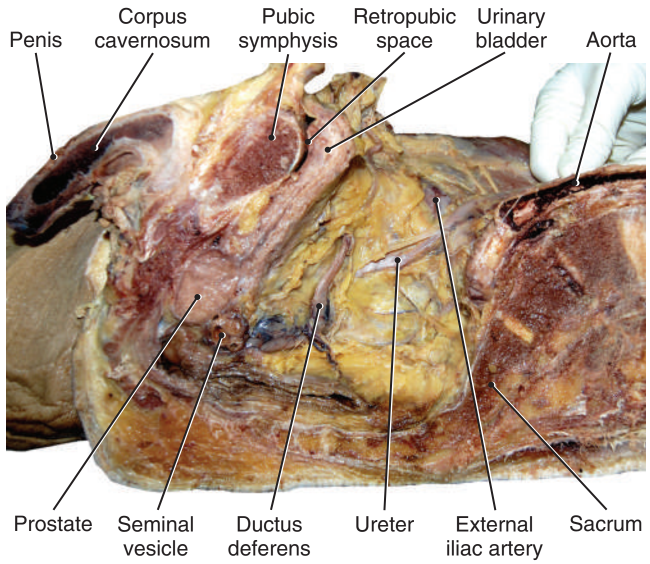
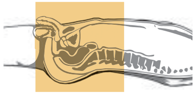

Penis
Corpus cavernosum
Pubic symphysis
Retropubic space
Urinary bladder
Aorta
Prostate
Seminal vesicle
Ductus deferens
Ureter
External iliac artery
Sacrum

Fig. 14.10 Soft tissue and adipose tissue cleaned around large structures.



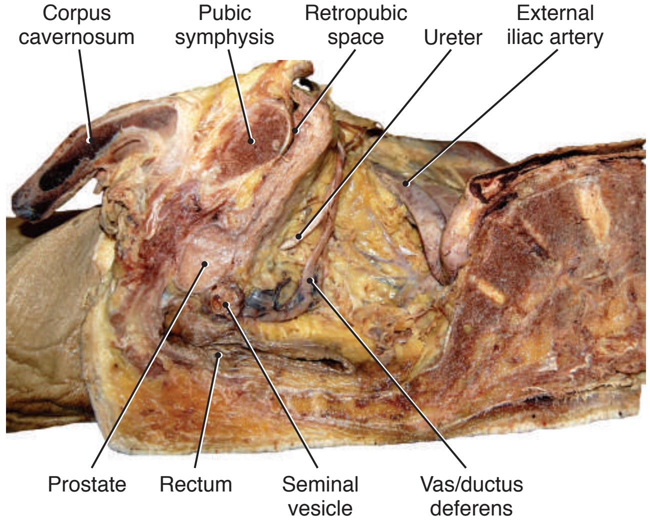
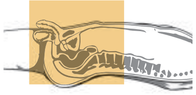

Corpus cavernosum
Pubic symphysis
Retropubic space
Ureter
External iliac artery
Prostate
Rectum
Seminal vesicle
Vas/ductus deferens

Fig. 14.11 Exposure of external iliac artery, with ductus deferens exposed toward prostate and ureter to its entrance.



DISSECTION TIP

The branches of the internal iliac artery are very variable. An easy way to avoid confusion is to rely on landmarks (discussed in dissection tips below), and always name the artery based on its distribution, not its origin.

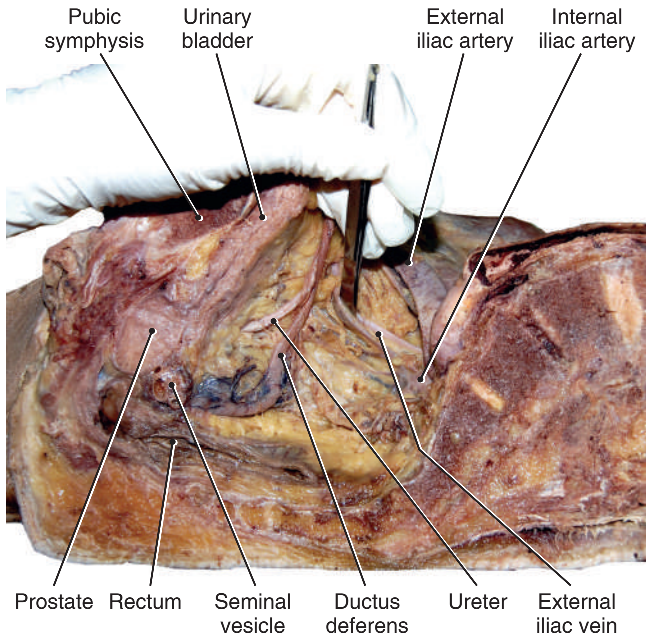
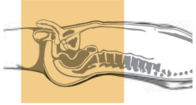

Pubic symphysis
Urinary bladder
External iliac artery
Internal iliac artery
Prostate
Rectum
Seminal vesicle
Ductus deferens
Ureter
External iliac vein

Fig. 14.12 External iliac vein retracted inferiorly. Ductus deferens and ureter exposed.



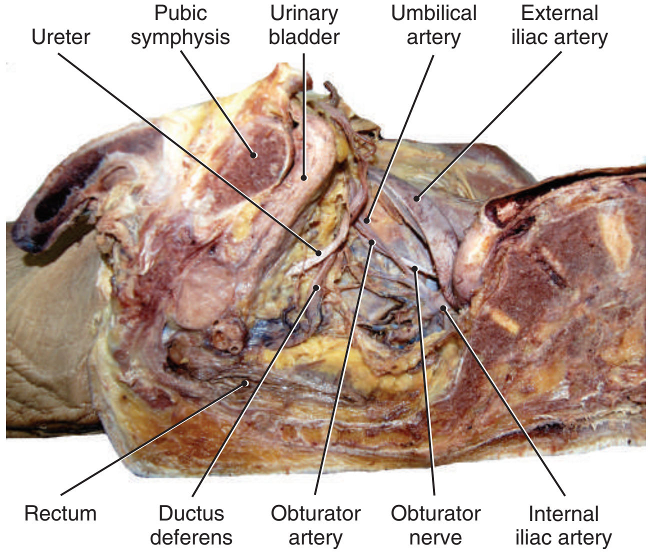
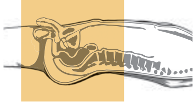

Ureter
Pubic symphysis
Urinary bladder
Umbilical artery
External iliac artery
Rectum
Ductus deferens
Obturator artery
Obturator nerve
Internal iliac artery

Fig. 14.13 Obturator nerve traced to obturator foramen.



- **Identify the internal iliac artery and expose its anterior and posterior divisions. Expose the branches of the anterior division of the internal iliac artery. These branches are the umbilical, obturator, inferior gluteal, internal pudendal, middle rectal, inferior vesical, and uterine arteries (Figs. 14.14 to 14.23). These arteries are discussed in the following dissection tips and figures.**

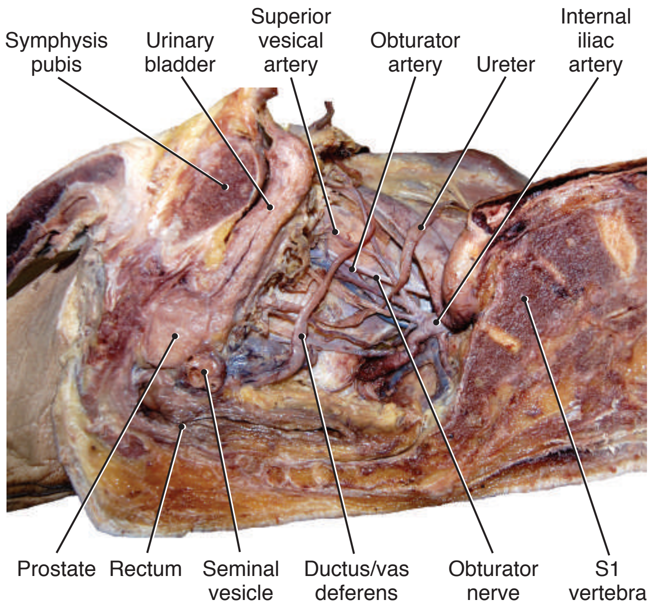

Symphysis pubis
Urinary bladder
Superior vesical artery
Obturator artery
Ureter
Internal iliac artery
Prostate
Rectum
Seminal vesicle
Ductus/vas deferens
Obturator nerve
S1 vertebra

Fig. 14.14 Internal iliac artery with anterior and posterior divisions.

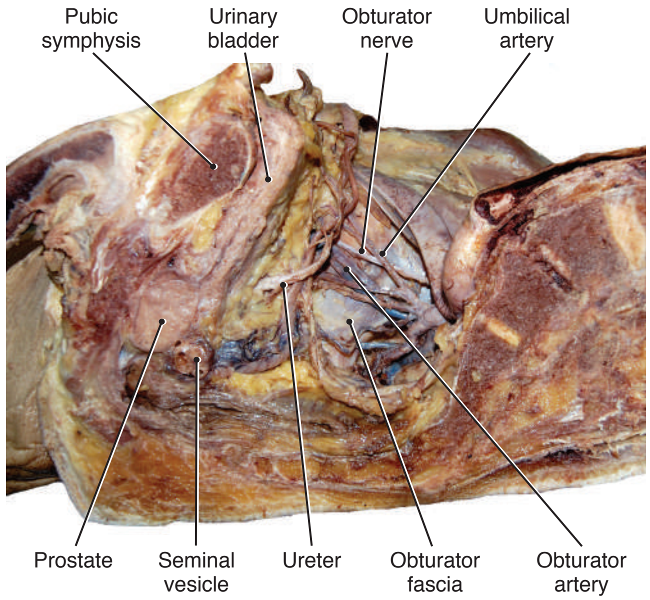

Pubic symphysis
Urinary bladder
Obturator nerve
Umbilical artery
Prostate
Seminal vesicle
Ureter
Obturator fascia
Obturator artery

Fig. 14.16 Appreciate major landmarks of pelvis in relation to branches of the internal iliac artery.

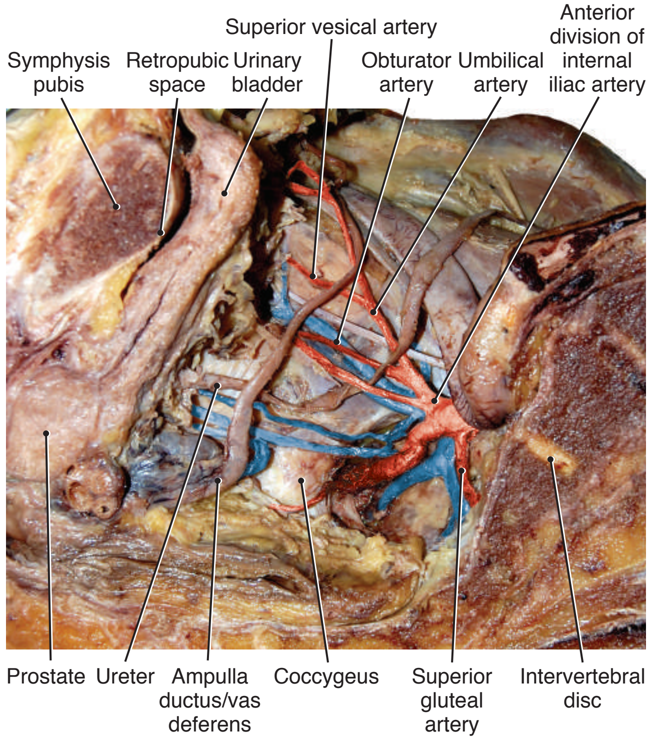

Symphysis pubis
Retropubic space
Urinary bladder
Superior vesical artery
Obturator artery
Umbilical artery
Anterior division of internal iliac artery
Prostate
Ureter
Ampulla ductus/vas deferens
Coccygeus
Superior gluteal artery
Intervertebral disc

Fig. 14.15 Branches of anterior division of internal iliac artery.

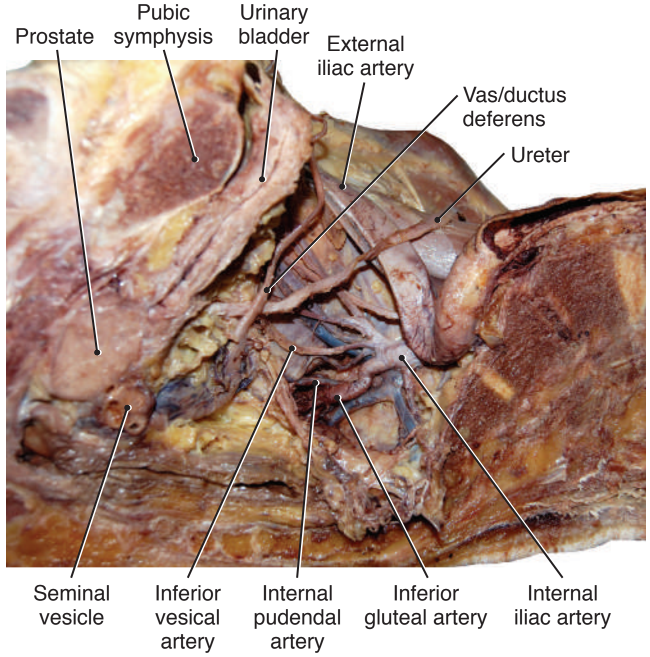

Prostate
Pubic symphysis
Urinary bladder
External iliac artery
Vas/ductus deferens
Ureter
Seminal vesicle
Inferior vesical artery
Internal pudendal artery
Inferior gluteal artery
Internal iliac artery

Fig. 14.17 Appreciate branches of the anterior division of the internal iliac artery.

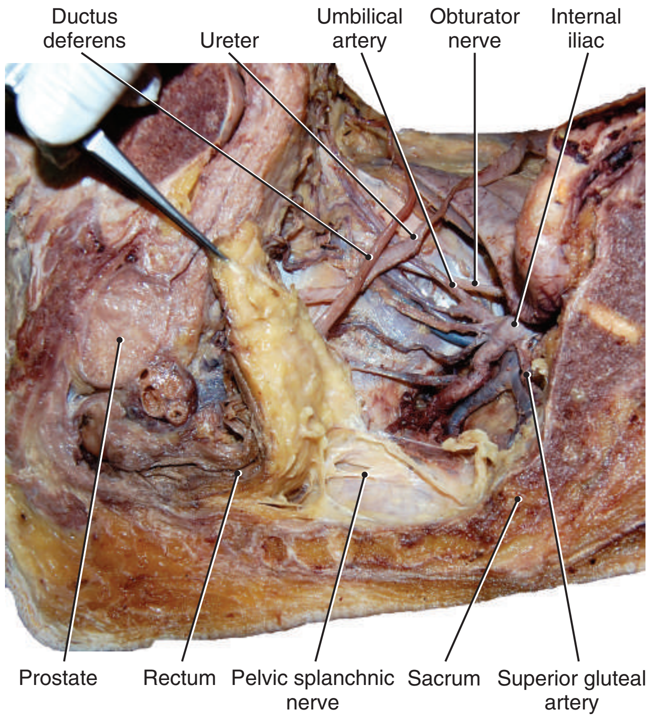

Ductus deferens
Ureter
Umbilical artery
Obturator nerve
Internal iliac
Prostate
Rectum
Pelvic splanchnic nerve
Sacrum
Superior gluteal artery

Fig. 14.18 Sympathetic trunk exposed in pelvis with gray communicating rami passing lateral to nerves of sacral plexus.

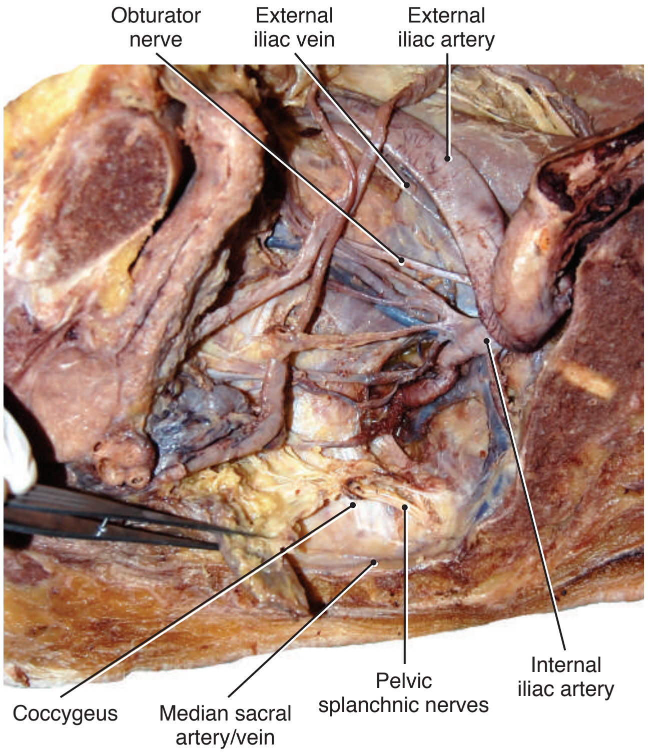

Obturator nerve
External iliac vein
External iliac artery
Internal iliac artery
Coccygeus
Median sacral artery/vein
Pelvic splanchnic nerves

Fig. 14.19 To expose pelvic splanchnic nerves fully, lift the rectum and anal canal superiorly.

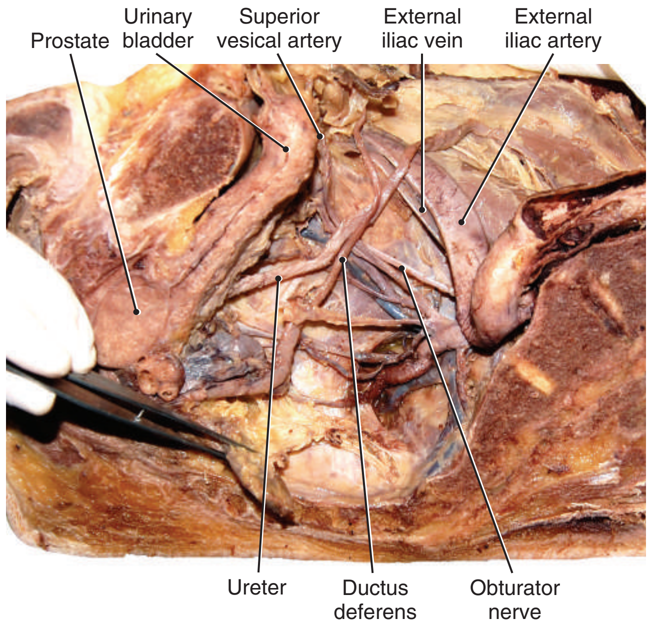

Prostate
Urinary bladder
Superior vesical artery
External iliac vein
External iliac artery
Ureter
Ductus deferens
Obturator nerve

Fig. 14.20 To expose pubococcygeus and iliococcygeus muscles, clean all the pelvic fascia and adipose tissue over the levator ani inferior to the prostate gland.

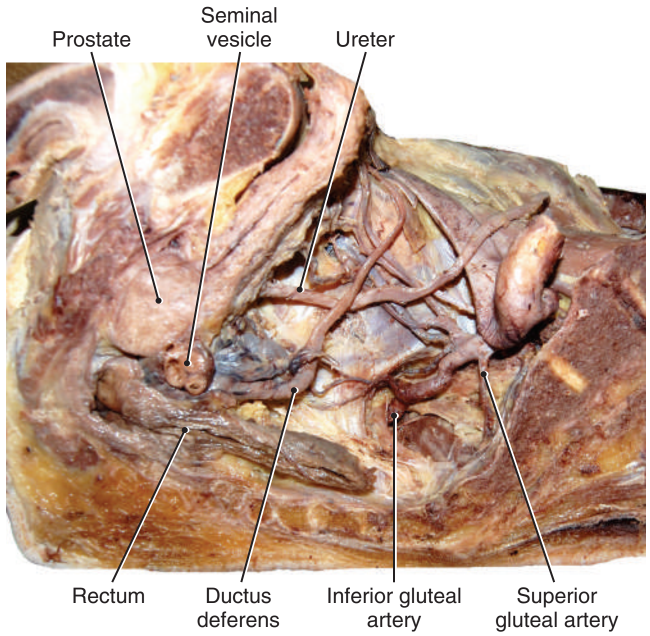

Prostate
Seminal vesicle
Ureter
Rectum
Ductus deferens
Inferior gluteal artery
Superior gluteal artery

Fig. 14.21 Identify the seminal vesicle and locate where the ductus deferens enters seminal vesicles.

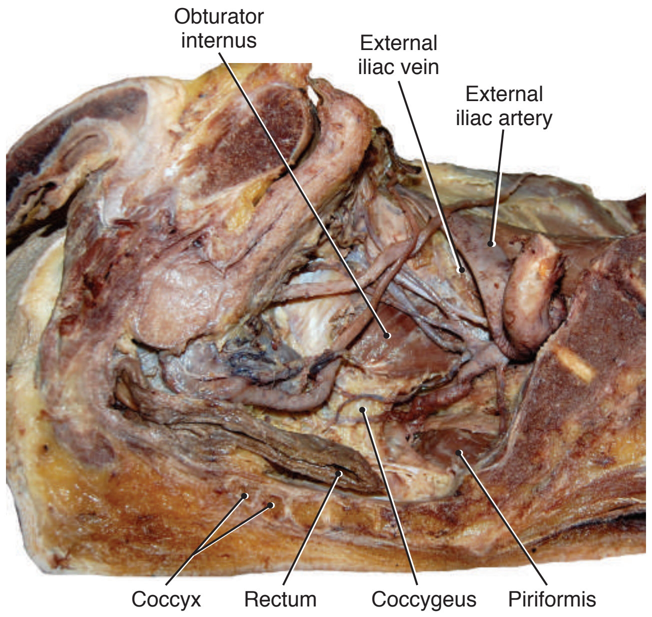


Fig. 14.22 Locate coccygeus muscle that arises from ischial spine and sacrospinous ligament and attaches to the coccyx and lower part of the sacrum.

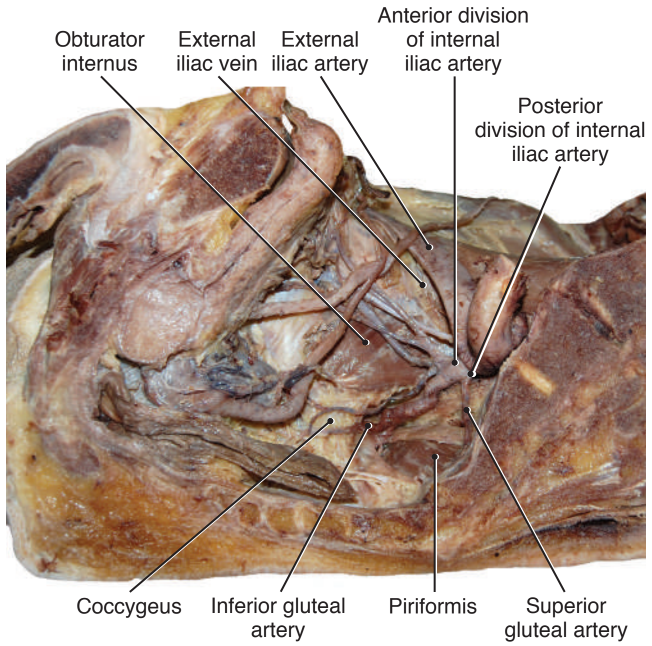


Fig. 14.23 Obturator internus fascia cleaned, exposing the obturator internus muscle.

DISSECTION TIPS

BRANCHES OF INTERNAL ILIAC ARTERY: ANTERIOR DIVISION (PLATE 14.1)

Umbilical artery: Usually the first branch of the anterior division. The umbilical artery courses upward and superior to the urinary bladder to become the median umbilical ligament (Figs. 14.13, 14.15, and 14.16). The umbilical artery often gives off the superior vesical branches that supply the superior portion of the urinary bladder; in 75% of cases, there are two or three superior vesical arteries.

Obturator artery: Usually arises parallel to the origin of the umbilical artery; travels with the obturator nerve to split into anterior and posterior branches in the obturator foramen (Figs. 14.14 and 14.15). The obturator artery travels anterior to the obturator internus and its fascia and is crossed medially by the ureter and the ductus deferens. It gives rise to small branches: iliac, vesical, and pubic.

The main variation of the obturator artery is that in 30% of cases, it arises from the inferior epigastric artery.

Inferior gluteal artery: Arises at the posterior side of the anterior division and is mainly distributed to the buttocks. The landmark for identifying the inferior gluteal artery is to look for the artery passing between the 1st and 2nd sacral nerves and between the piriformis and coccygeus muscles (Fig. 14.17).

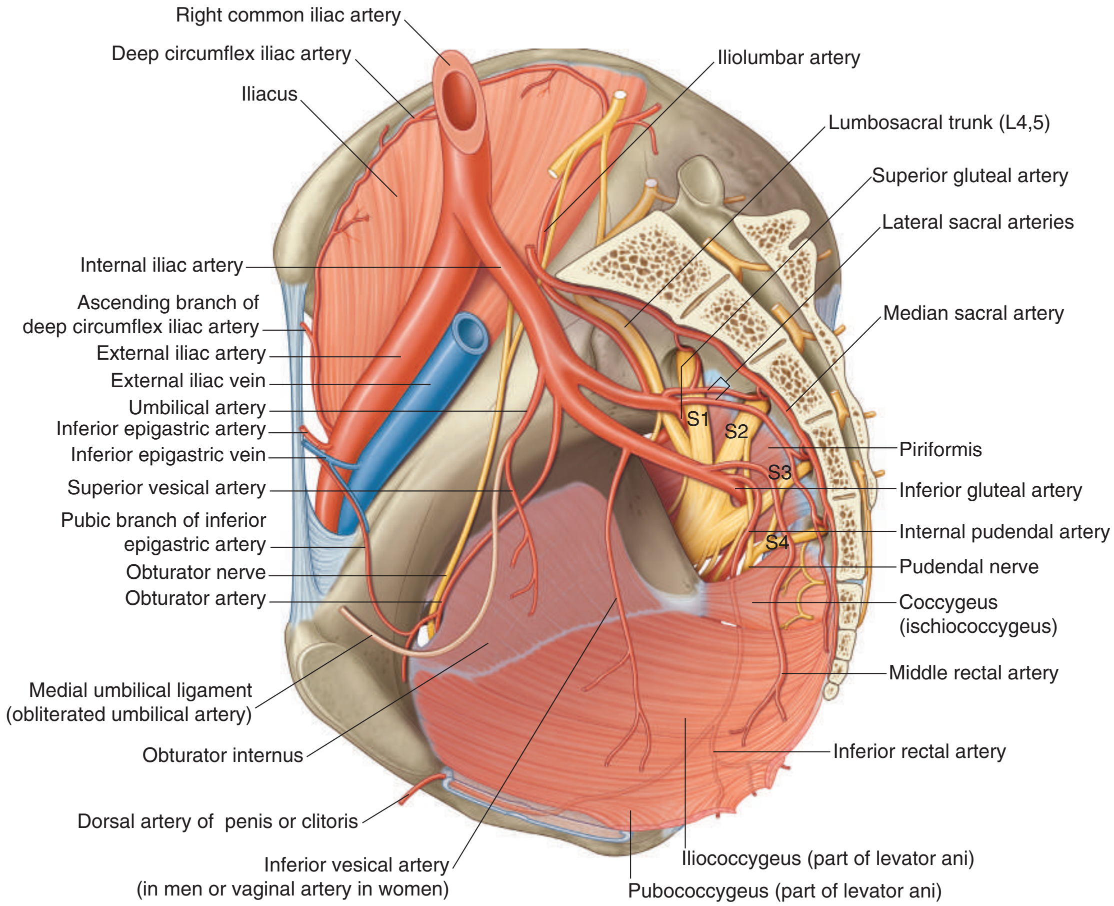
Internal pudendal artery: The artery is more anterior in position than the inferior gluteal artery as these arteries leave the pelvis. The internal pudendal artery does not pass between S1 and S2 nerves but typically courses lower between the piriformis and coccygeus muscles (Fig. 14.17). It also accompanies the pudendal nerve to Alcock's canal. Several small branches arise from the internal pudendal artery: inferior rectal, perineal, artery of the bulb, urethral artery, deep artery of the penis or clitoris, and dorsal artery of the penis or clitoris.

Middle rectal: It arises with or from the internal pudendal, inferior vesical, or inferior gluteal arteries; mainly supplies the rectum.

Inferior vesical (**vaginal** in females): Usually arises from the internal pudendal artery. The inferior vesical artery supplies the fundus of the urinary bladder, the prostate, and the seminal vesicles.

Uterine: Usually arises from the medial surface of the anterior trunk. It runs medially on the levator ani and the broad ligament, and at about 2 cm at the cervix of the uterus, it crosses in front of the ureter to anastomose with the ovarian artery. The uterine artery typically gives off a *superior* branch, supplying the body and fundus of the uterus, and a *vaginal* branch, supplying the cervix and vagina.

- **Expose the branches of the posterior division of the internal iliac artery: These branches are the iliolumbar, lateral sacral, and the superior gluteal arteries.**


Right common iliac artery
Deep circumflex iliac artery
Iliacus
Iliolumbar artery
Lumbosacral trunk (L4,5)
Superior gluteal artery
Lateral sacral arteries
Median sacral artery
Internal iliac artery
Ascending branch of deep circumflex iliac artery
External iliac artery
External iliac vein
Umbilical artery
Inferior epigastric artery
Inferior epigastric vein
Superior vesical artery
Pubic branch of inferior epigastric artery
Obturator nerve
Obturator artery
S1
S2
S3
S4
Piriformis
Inferior gluteal artery
Internal pudendal artery
Pudendal nerve
Coccygeus (ischiococcygeus)
Middle rectal artery
Medial umbilical ligament (obliterated umbilical artery)
Obturator internus
Inferior rectal artery
Dorsal artery of penis or clitoris
Inferior vesical artery (in men or vaginal artery in women)
Iliococcygeus (part of levator ani)
Pubococcygeus (part of levator ani)

Arterial supply to the pelvis
(right side sagittal view)

Plate 14.1 Arteries of the pelvis.

DISSECTION **TIPS**

BRANCHES OF INTERNAL ILIAC ARTERY: POSTERIOR DIVISION (SEE PLATE 14.1)

Iliolumbar: This artery typically is found between the lumbosacral trunk and the obturator nerve. It then ascends superolaterally to the iliac fossa, finally to reach the psoas major muscle. The iliolumbar artery gives off an iliac and a lumbar branch.

Lateral sacral: Usually, two lateral sacral arteries are present, superior and inferior. The *superior* lateral sacral artery usually enters the 1st or 2nd sacral foramina. The *inferior* lateral sacral artery runs obliquely across the piriformis muscle to the medial side of the sacral foramina. It anastomoses with the middle sacral artery.

Superior gluteal: Largest branch of the posterior trunk and a direct continuation of its posterior trunk. The superior gluteal artery runs backward between the lumbosacral trunk and the 1st sacral nerve (Figs. 14.15 and 14.18). It divides into superficial and deep branches in the buttock.

- Behind the internal and external iliac arteries, identify the obturator internus muscle covered with the obturator fascia (a part of the endopelvic fascia).

- Expose the inferior part of the obturator fascia and note its white, thickened band of fibers, the *tendinous arch of the levator ani* (arcus tendineus levator ani).

ANATOMY **NOTE**

The tendinous arch runs from the obturator internus to the posterior part of the pubic bone and serves as an attachment site for the fibers of the levator ani muscle (Fig. 14.29). The tendinous arch is continuous with the obturator internus fascia.

The floor of the pelvis is mainly composed of the levator ani (anteriorly) and the coccygeus (posteriorly) muscles, forming the *pelvic diaphragm* (Fig. 14.19).

The levator ani consists mainly of the pubococcygeus muscle arising from the anterior/middle portion of the tendinous arch of levator ani and the iliococcygeus. It further divides into the puborectalis and pubovaginalis (in females) muscles and the levator prostatae (in males) muscles.

The iliococcygeus muscle arises mainly from the tendineus arch of the levator ani and attaches to the coccyx. The coccygeus muscle arises from the ischial spine and sacrospinous ligament and attaches to the coccyx and lower part of the sacrum (Fig. 14.22).

DISSECTION **TIP**

To expose the pubococcygeus and the iliococcygeus muscles, clean all the pelvic fascia and adipose tissue over the levator ani muscle inferior to the prostate gland (see Figs. 14.20 and 14.21). These muscles are often atrophied, and clear borders may be difficult to identify.

- Clean the superior fascia of the pelvic diaphragm, which covers the levator ani. Note the continuity of the tendinous arch of the levator ani and the obturator internus fascia.
- Clean the obturator internus fascia and expose the obturator internus muscle (Figs. 14.22 and 14.23).
- Expose the sympathetic trunk in the pelvis, and observe the pelvic gray communicating rami passing lateral to nerves of the sacral plexus (there are no white communicating rami below the level of L2 or L3) and the origins of the pelvic splanchnic nerves (see Figs. 14.18 and 14.19; Plate 14.2).
- To expose the pelvic splanchnic nerves completely, lift the rectum and anal canal superiorly. Note the pelvic splanchnic nerves penetrating the piriformis and coccygeus muscles to reach the lateral wall of the rectum. Trace the obturator nerve through the obturator foramen, and expose the lumbosacral trunk and the sacral nerves.
- Expose the ductus deferens to the seminal vesicles. Expose the dilation of the ductus deferens near the seminal vesicle, the *ampulla.* Expose the seminal vesicles, and identify the ejaculatory duct formed by the union of the ductus deferens and the seminal vesicle.
- Identify the prostate gland and expose its superior portion, the base, which is in contact with the urinary bladder. On either side of the prostate, palpate, if possible, the lateral lobes. Look for the wedge-shaped median lobe, located anterior to the ejaculatory ducts. Palpate the posterior lobe.

Dissection of the Female Pelvis

- Identify the broad ligament with its different portions—the mesosalpinx, mesovarium, and mesometrium.
- Identify the ovaries and the peritoneal fold covering the ovarian vessels, the suspensory ligament (infundibulopelvic) (Fig. 14.24).
- Identify the proper ligament of the ovary.

DISSECTION **TIP**

This ovarian ligament connects to the body of the uterus and the round ligament of the uterus.

- At the base of the broad ligament, look for a thickening of the endopelvic fascia, the cardinal ligament (ligament of Mackenrodt). Inferiorly, identify the uterosacral ligament connecting the uterus to the sacrum.

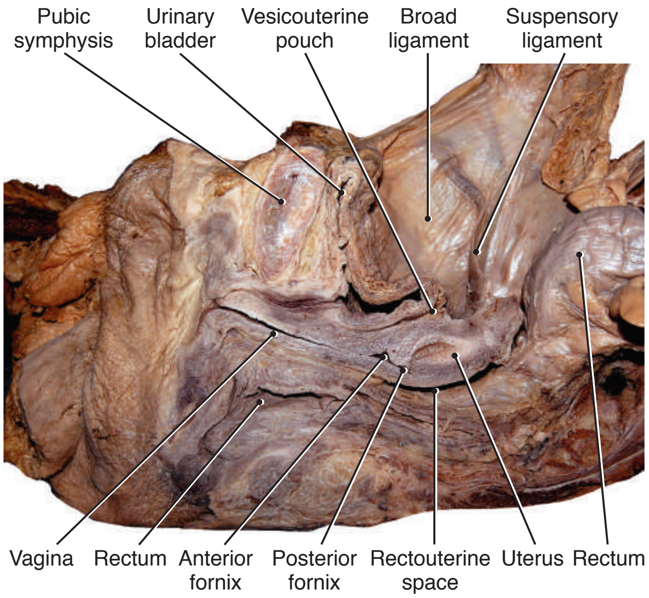


Fig. 14.24 Broad ligament of uterus and suspensory ligament of ovary; appreciate the relationship between the rectum and uterus forming the pouch of Douglas (retrovesical space).

DISSECTION **TIP**

The cardinal and uterosacral ligaments may be difficult to identify in the cadaver. However, by pulling the uterus anteriorly toward the pubic symphysis and to the right, you may feel the left uterosacral ligament.

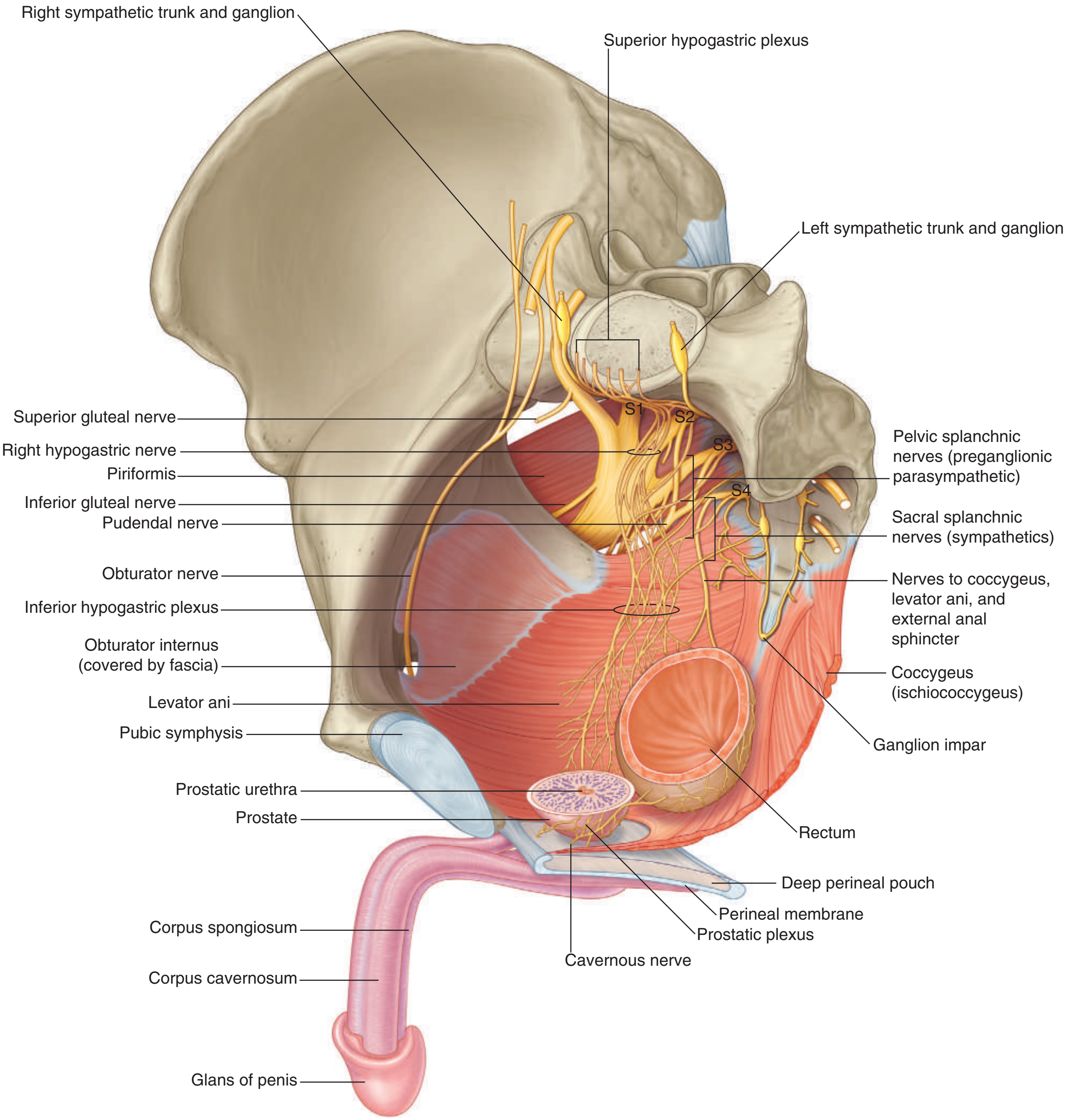
- On the hemisected uterus, identify the fundus, body and cervix. Anterior to the cervix, identify the vagina. The deepest portion of the vagina behind the cervix is the posterior fornix (Figs. 14.24 and 14.25).
- On the hemisected pelvis observe the most inferior portion of the abdomen, the pouch of Douglas (rectouterine space) (Fig. 14.24).

ANATOMY **NOTE**

A connective tissue septum extends inferiorly from the pouch of Douglas (retrovesical space) between the rectum and the vagina/uterus to attach to the perineal body, the rectovaginal septum (fascia of Denonvilliers). Its counterpart in the male is the rectoprostatic septum.

Ongoing Dissection of Male Pelvis

- With a paper towel, clean the contents of the rectum and anal canal. Internally, identify the transverse folds of the rectum (valves of Houston), the anal columns (of Morgagni), and the pectinate line (Fig. 14.26).
- Make a midsagittal incision through the prostate gland, and identify the three portions of the urethra: prostatic, membranous, and the spongy (Fig. 14.27). Within the prostatic urethra, identify an elevation, the *urethral crest,* and in the midline, the opening of the prostatic


Right sympathetic trunk and ganglion
Superior hypogastric plexus
Left sympathetic trunk and ganglion
S1
S2
S3
S4
Superior gluteal nerve
Right hypogastric nerve
Piriformis
Inferior gluteal nerve
Pudendal nerve
Obturator nerve
Inferior hypogastric plexus
Obturator internus (covered by fascia)
Levator ani
Pubic symphysis
Prostatic urethra
Prostate
Corpus spongiosum
Corpus cavernosum
Glans of penis
Pelvic splanchnic nerves (preganglionic parasympathetic)
Sacral splanchnic nerves (sympathetics)
Nerves to coccygeus, levator ani, and external anal sphincter
Coccygeus (ischiococcygeus)
Ganglion impar
Rectum
Deep perineal pouch
Perineal membrane
Prostatic plexus
Cavernous nerve

Hypogastric nerve plexuses (oblique sagittal view)

Plate 14.2 Nerves of the pelvis.

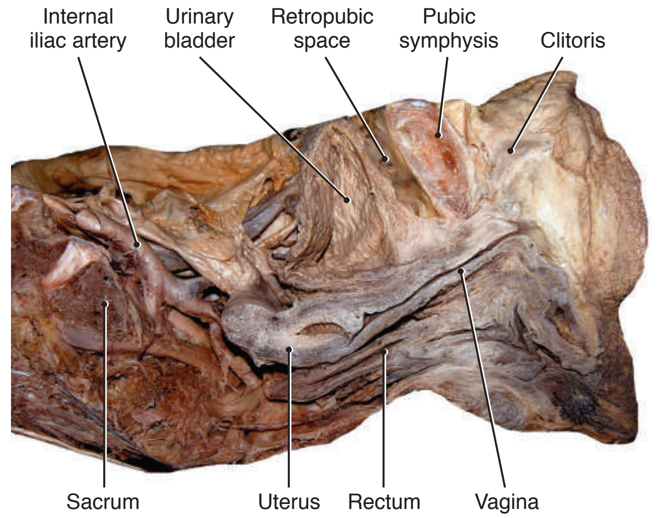

Internal iliac artery
Urinary bladder
Retropubic space
Pubic symphysis
Clitoris
Sacrum
Uterus
Rectum
Vagina

Fig. 14.25 Vaginal canal with anterior and posterior fornices.

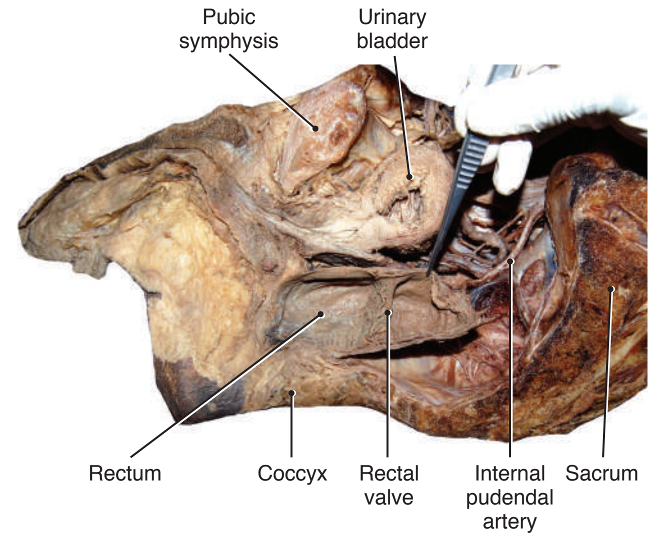
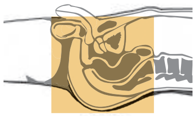

Pubic symphysis
Urinary bladder
Rectum
Coccyx
Rectal valve
Internal pudendal artery
Sacrum

Fig. 14.26 In this specimen, note internal structures of rectum and anal canal (transverse folds, valves of Houston).



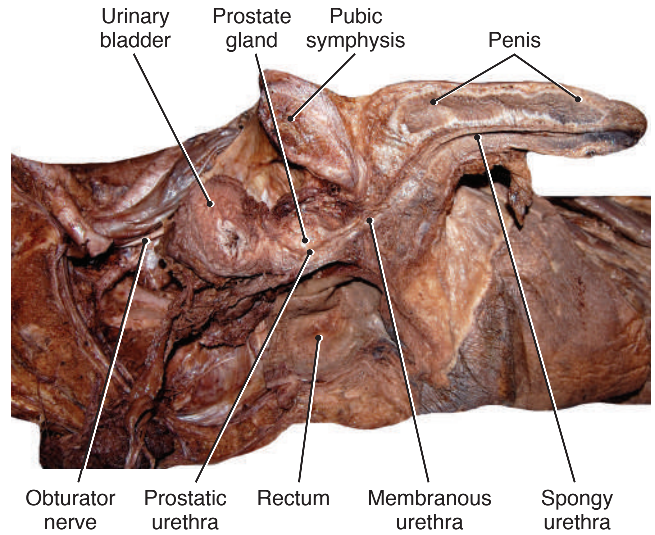

Urinary bladder
Prostate gland
Pubic symphysis
Penis
Obturator nerve
Prostatic urethra
Rectum
Membranous urethra
Spongy urethra

Fig. 14.27 In this hemisected pelvis, appreciate anatomic components of urethra (prostatic, membranous, and spongy parts).

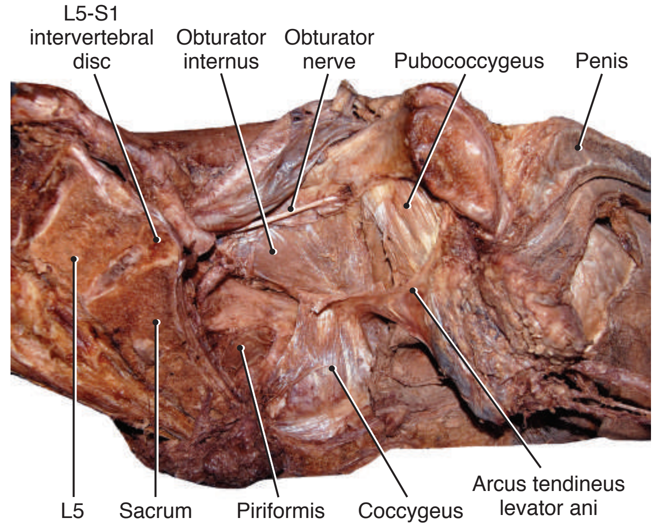
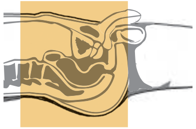

L5-S1 intervertebral disc
Obturator internus
Obturator nerve
Pubococcygeus
Penis
L5
Sacrum
Piriformis
Coccygeus
Arcus tendineus levator ani

Fig. 14.28 Arteries and veins removed and musculature exposed; *L5,* 5th lumbar; *S1,* 1st sacral.



utricle. Lateral and distal to the prostatic utricle, identify the ejaculatory ducts. Lateral to the urethral crest, identify the openings of the prostatic ducts.

- In Fig. 14.28 the arteries and veins have been removed and the underlying musculature has been exposed.
- Pull the hemisected urinary bladder medially and posteriorly, and identify the puboprostatic ligaments (pubovesical in females) lying laterally between the pubic symphysis and the bladder (Fig. 14.29).
- Identify the trigone of the urinary bladder.

DISSECTION **TIP**

Trigone identification is difficult in the hemisected specimen because the incision plane usually transects it.

- Identify the ureteric orifice and the interureteric ridge or crest created by a muscular fold between the two ureteric orifices. The orifice of the urethra forms a muscular elevation, the *uvula.*
- Lift the rectum upward, and expose the pelvic splanchnic nerves (Fig. 14.30).

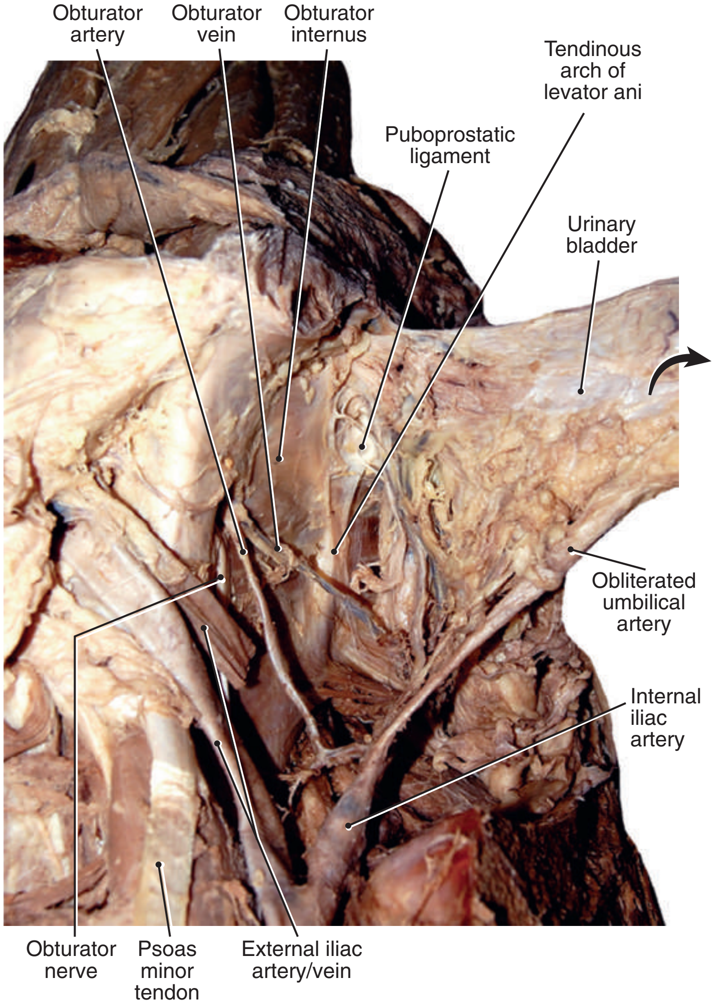

Obturator artery
Obturator vein
Obturator internus
Tendinous arch of levator ani
Puboprostatic ligament
Urinary bladder
Obliterated umbilical artery
Internal iliac artery
Obturator nerve
Psoas minor tendon
External iliac artery/vein

Fig. 14.29 Urinary bladder retracted medially and puboprostatic ligaments identified in the space between the obturator internus muscle and urinary bladder, just behind the pubic symphysis.

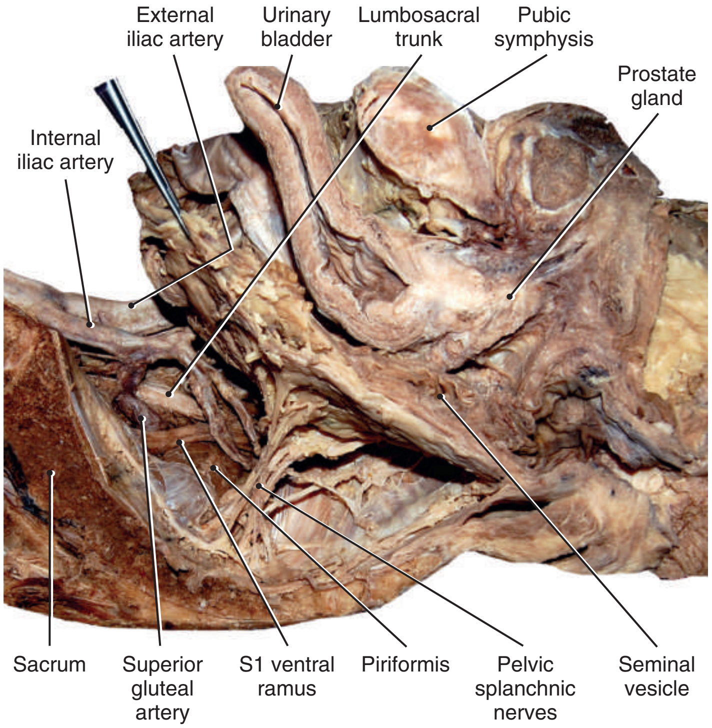
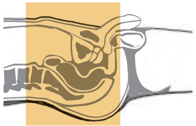

External iliac artery
Urinary bladder
Lumbosacral trunk
Pubic symphysis
Prostate gland
Internal iliac artery
Sacrum
Superior gluteal artery
S1 ventral ramus
Piriformis
Pelvic splanchnic nerves
Seminal vesicle

Fig. 14.30 Rectum lifted upward to expose pelvic splanchnic nerves. *S1*, 1st sacral vertebra.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Pudendal
- ☐ Obturator
- ☐ Lumbosacral trunk
- ☐ S1 ventral rami
- ☐ S2 ventral rami
- ☐ S3 ventral rami
- ☐ S4 ventral rami
- ☐ Pelvic splanchnic
- ☐ Sacral sympathetic trunk/ganglia
- ☐ Superior hypogastric plexus
- ☐ Inferior hypogastric plexus
- ☐ Sacral splanchnic nerves

ARTERIES

- ☐ Aorta
- ☐ Middle sacral
- ☐ Common iliac
  - ☐ External iliac
  - ☐ Internal iliac
    - ☐ *Anterior division*
    - ☐ Umbilical
    - ☐ Superior vesical
    - ☐ Obturator
    - ☐ Uterine
    - ☐ Vaginal
    - ☐ Inferior gluteal
    - ☐ *Posterior division*
    - ☐ Lateral sacral
    - ☐ Iliolumbar
    - ☐ Superior gluteal
- ☐ Gonadal (testicular/ovarian)
- ☐ Internal pudendal
- ☐ Superior rectal

VEINS

- ☐ Inferior vena cava
- ☐ Common iliac
  - ☐ External iliac
  - ☐ Internal iliac

MUSCLES

- ☐ Piriformis
- ☐ Obturator internus
- ☐ Levator ani
- ☐ Coccygeus
- ☐ Pubococcygeus
- ☐ Iliococcygeus

CONNECTIVE TISSUE

- ☐ Pelvic fascia
- ☐ Obturator fascia

LIGAMENTS

- ☐ Sacrotuberous
- ☐ Sacrospinous
- ☐ Iliolumbar
- ☐ Broad
- ☐ Uterosacral
- ☐ Lateral (cardinal, Mackenrodt)

ORGANS/URINARY/REPRODUCTIVE

- ☐ Urinary bladder
- ☐ Ureter
- ☐ Sigmoid colon
- ☐ Rectosigmoid junction
- ☐ Rectum
- ☐ Anal canal

Male

- ☐ Prostate gland
- ☐ Seminal vesicle
- ☐ Ductus deferens

Female

- ☐ Uterus
- ☐ Fallopian tube
- ☐ Ovary

SPACES

- ☐ Retropubic
- ☐ Retrovesical (pouch of Douglas)
- ☐ Retrouterine

BONES

- ☐ Sacrum
- ☐ Coccyx
- ☐ Os coxae (hip bone)
  - ☐ Ilium
  - ☐ Ischium
  - ☐ Pubic

CHAPTER 15 PERINEUM

ATLAS REFERENCES

Netter: 358–365, 377, 378, 387, 389, 393, 395, 486–489
McMinn: 276–279
Gray's Atlas: 255–263, 266, 267, 270

BEFORE YOU BEGIN

Dissection of the male and female pelvis is discussed separately in this chapter.

DISSECTION **TIP**

To best dissect the perineum, first perform the gluteal region dissection, including the ischioanal fossae and thighs. This makes it much easier to expose and dissect the structures of the perineum.

DISSECTION OF THE MALE CADAVER

- Place the cadaver in the supine position. Place a block under the sacrum and abduct the thighs as far as possible. A wooden block or rod is placed between the thighs at the level of the femoral condyles to maintain them in abduction (Fig. 15.1).
- Identify the adductor longus and gracilis muscles. These muscles can be transected so that the thighs can be abducted more easily. In this specimen, it was not necessary to transect these muscles (Fig. 15.2).
- Draw imaginary lines outlining the borders of the *urogenital triangle:* a line between the ischial tuberosities and two lines along the ischiopubic rami to the pubic symphysis (Fig. 15.3). At the midpoint of a line connecting the two ischial tuberosities, palpate a fibromuscular mass of tissue, the *perineal body*.

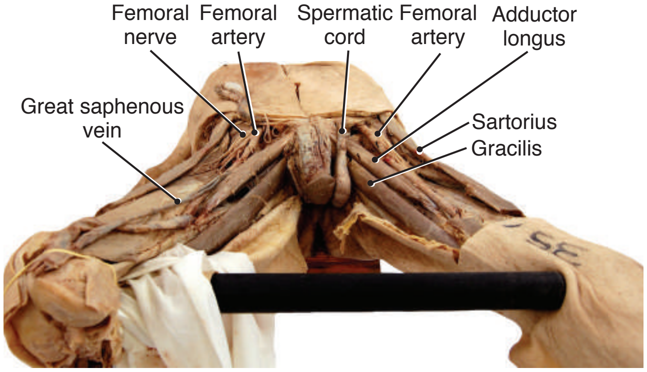

Femoral nerve
Femoral artery
Spermatic cord
Femoral artery
Adductor longus
Great saphenous vein
Sartorius
Gracilis

Fig. 15.1 Male cadaver in supine position with block under sacrum with thighs abducted.

ANATOMY **NOTE**

The perineal body is an important structure because the superficial and deep transverse perineus muscles, the bulbospongiosus muscle, the levator ani muscle, and the external anal sphincter muscles are attached to it.

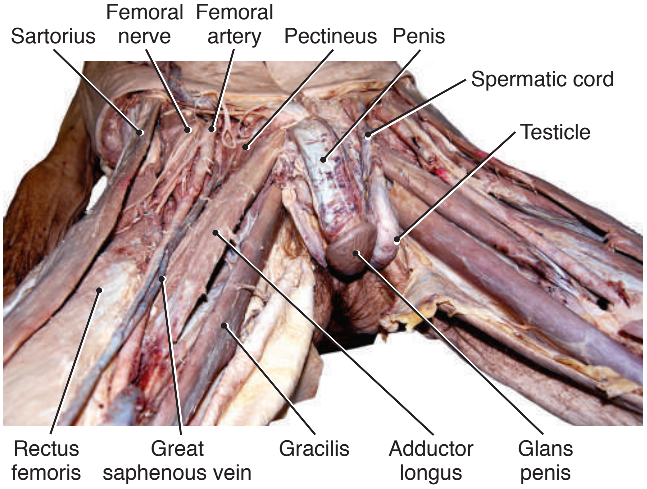

Sartorius
Femoral nerve
Femoral artery
Pectineus
Penis
Spermatic cord
Testicle
Rectus femoris
Great saphenous vein
Gracilis
Adductor longus
Glans penis

Fig. 15.2 Transecting the adductor longus and gracilis muscles to abduct thighs more easily was not necessary in this cadaver.

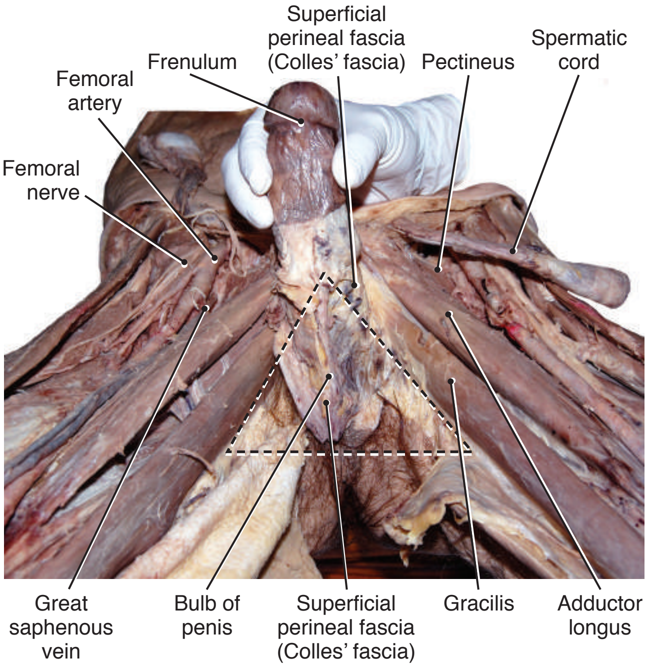

Superficial perineal fascia (Colles' fascia)
Frenulum
Femoral artery
Pectineus
Spermatic cord
Femoral nerve
Great saphenous vein
Bulb of penis
Superficial perineal fascia (Colles' fascia)
Gracilis
Adductor longus

Fig. 15.3 Urogenital triangle *(dashed outline),* with line between ischial tuberosities and two lines along ischiopubic rami to pubic symphysis.

- Remove the skin of the urogenital region, including the scrotum. Reflect the testis toward the inguinal ligament, and expose the urogenital triangle. Lift the penis upward, and remove the adipose tissue and the rich venous network (Fig. 15.4).

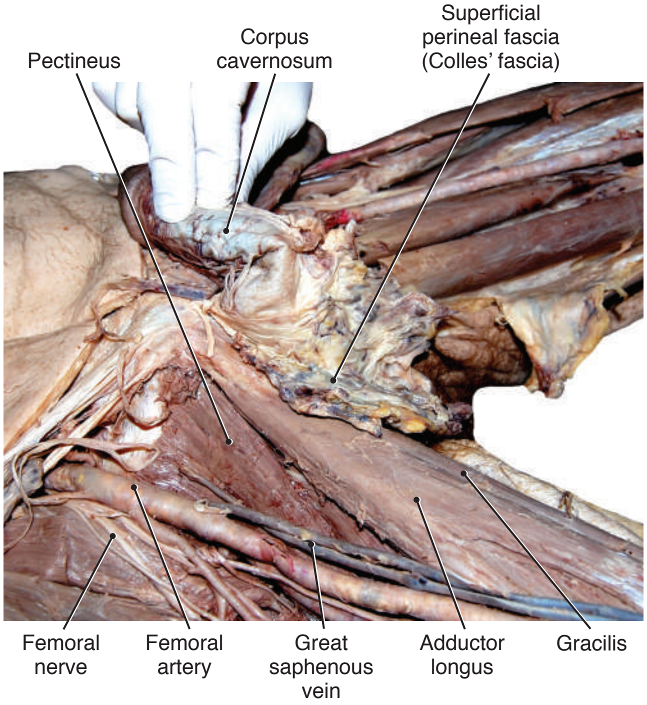
ANATOMY **NOTE**

The fat that is removed here is located in the superficial perineal fascia (of Colles). This fascia is the continuation of Scarpa's fascia (membranous layer of anterior abdominal wall) into the perineum (Figs. 15.5 and 15.6). Camper's fascia (fatty layer of anterior abdominal wall) continues into the perineum (Plate 15.1).

DISSECTION **TIP**

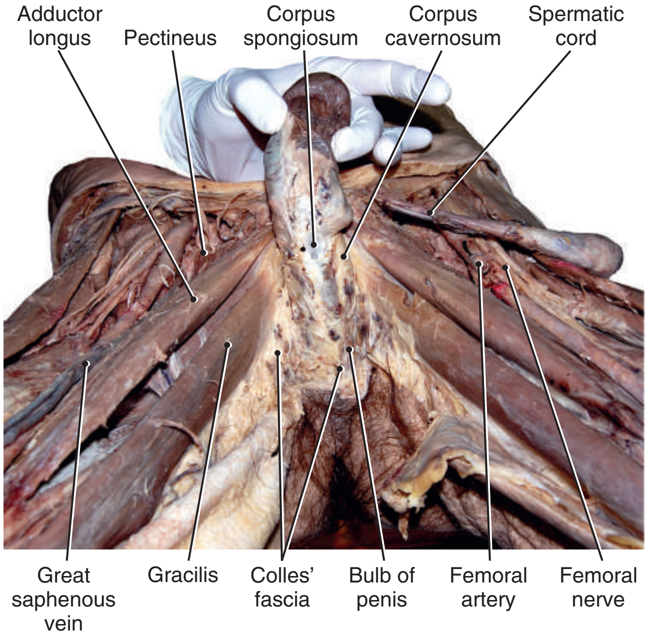
The superficial perineal fascia is fairly thick and intermingled with the adipose tissue of the urogenital triangle. This fascia attaches laterally to the ischiopubic rami.

- Remove Colles' fascia, and identify the corpus cavernosum laterally and the corpus spongiosum medially (see Fig. 15.6).
- Expose the bulbospongiosus muscle covered with a fascial layer, the *deep perineal fascia* (Gallaudet's fascia).



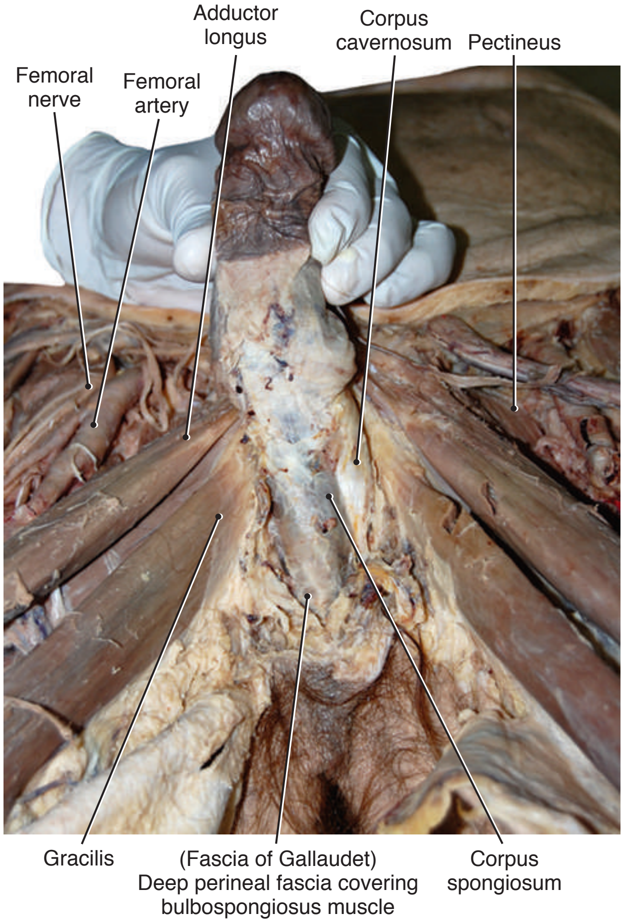
Pectineus
Corpus cavernosum
Superficial perineal fascia (Colles' fascia)
Femoral nerve
Femoral artery
Great saphenous vein
Adductor longus
Gracilis

Fig. 15.4 Skin of urogenital region removed and testis reflected toward inguinal ligament, exposing urogenital triangle.



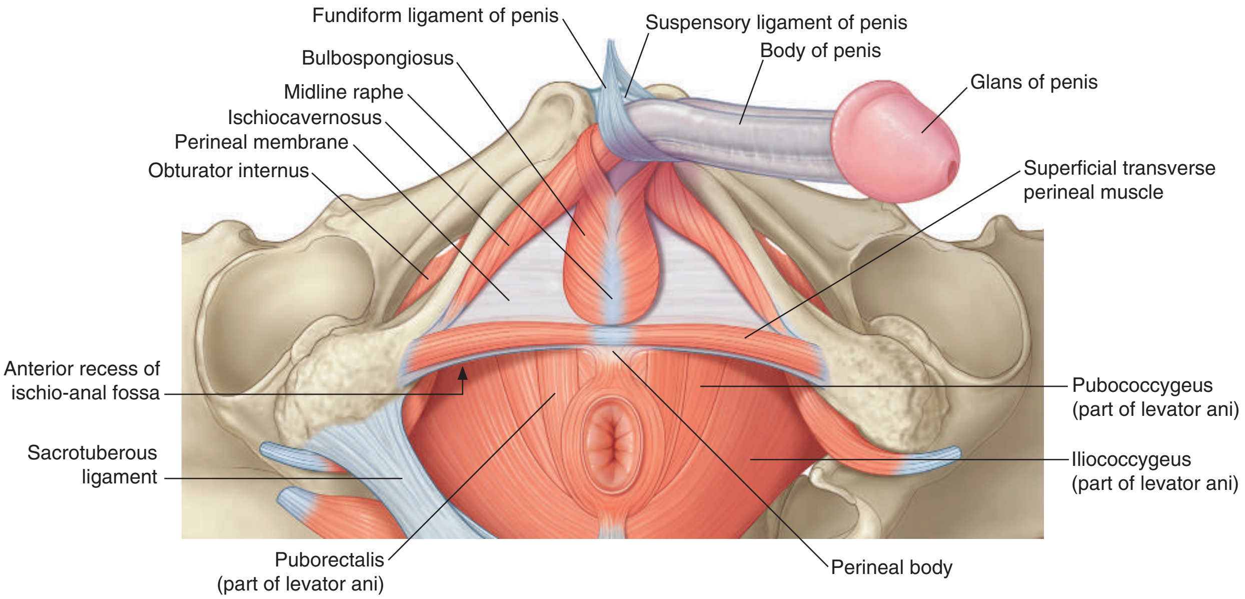
Adductor longus
Pectineus
Corpus spongiosum
Corpus cavernosum
Spermatic cord
Great saphenous vein
Gracilis
Colles' fascia
Bulb of penis
Femoral artery
Femoral nerve

Fig. 15.5 Lift the penis upward and remove the adipose tissue and the rich venous network.



Adductor longus
Corpus cavernosum
Pectineus
Femoral nerve
Femoral artery
Gracilis
(Fascia of Gallaudet) Deep perineal fascia covering bulbospongiosus muscle
Corpus spongiosum

Fig. 15.6 Colles' fascia removed to identify corpus cavernosum laterally and corpus spongiosum medially. Bulbospongiosus muscle is covered with deep perineal fascia.


Fundiform ligament of penis
Suspensory ligament of penis
Body of penis
Bulbospongiosus
Glans of penis
Midline raphe
Ischiocavernosus
Perineal membrane
Obturator internus
Superficial transverse perineal muscle
Anterior recess of ischio-anal fossa
Pubococcygeus (part of levator ani)
Sacrotuberous ligament
Iliococcygeus (part of levator ani)
Puborectalis (part of levator ani)
Perineal body

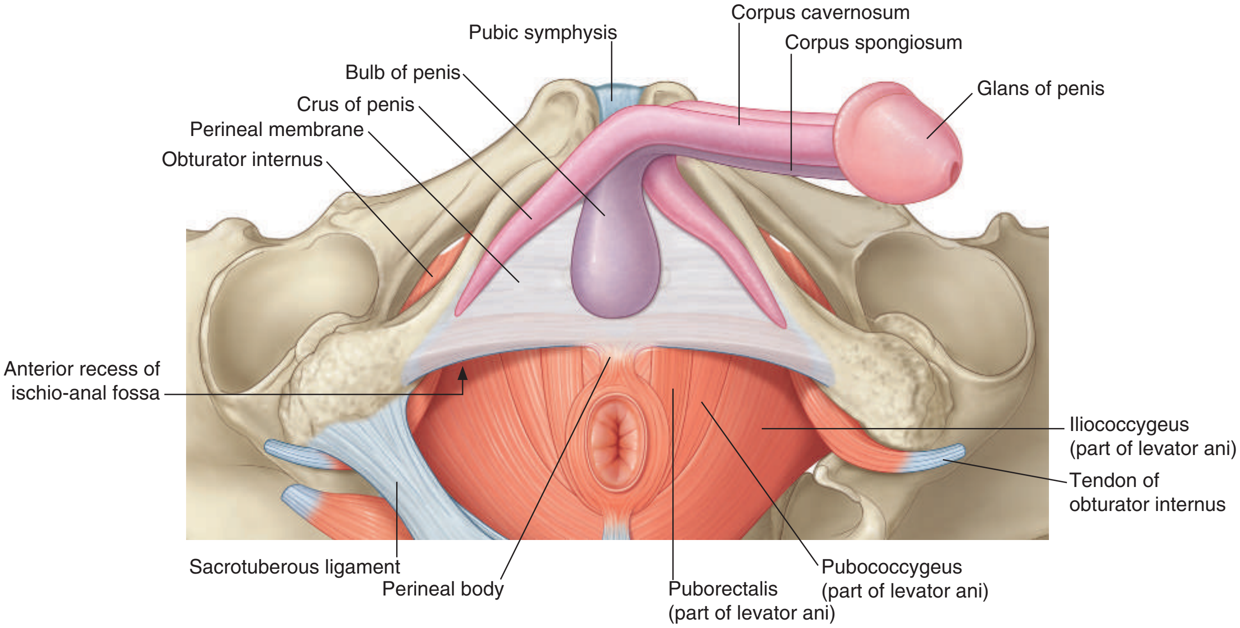

Corpus cavernosum
Pubic symphysis
Corpus spongiosum
Bulb of penis
Glans of penis
Crus of penis
Perineal membrane
Obturator internus
Anterior recess of ischio-anal fossa
Iliococcygeus (part of levator ani)
Tendon of obturator internus
Sacrotuberous ligament
Pubococcygeus (part of levator ani)
Perineal body
Puborectalis (part of levator ani)

Plate 15.1 Muscles of the superficial perineal pouch in males.

ANATOMY **NOTE**

The deep perineal fascia invests the bulbospongiosus muscle, superficial transverse perineal muscles, and ischiocavernosus muscles.

DISSECTION **TIP**

During the removal of the superficial perineal cleft, you may encounter branches of the posterior femoral cutaneous nerve, as well as scrotal vessels and nerves.

- **Continue the exposure of the bulbospongiosus inferiorly, exposing the deep perineal fascia. The potential space between the superficial perineal fascia and deep perineal fascia is called the *superficial perineal cleft* (space between Colles' and Gallaudet's fasciae) (Figs. 15.7 and 15.8).**

- **Dissect lateral to the bulbospongiosus muscle and identify the ischiocavernosus muscle arising from the ischiopubic rami (see Fig. 15.8). The ischiocavernosus surrounds the crus of the penis (corpora cavernosa), a bilateral collection of erectile tissue (Fig. 15.9).**

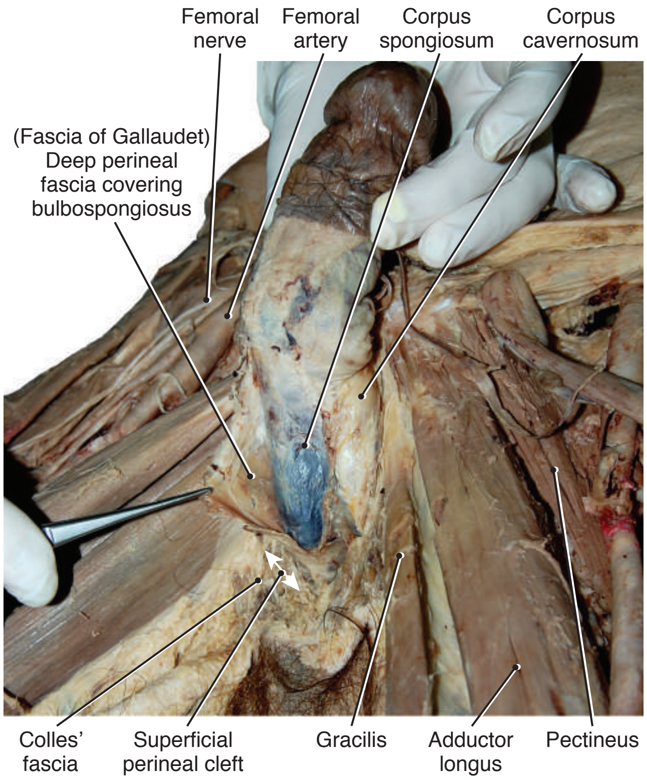

Femoral nerve
Femoral artery
Corpus spongiosum
Corpus cavernosum
(Fascia of Gallaudet) Deep perineal fascia covering bulbospongiosus
Colles' fascia
Superficial perineal cleft
Gracilis
Adductor longus
Pectineus

Fig. 15.7 Exposure of bulbospongiosus muscle continued inferiorly, further revealing the deep perineal fascia.

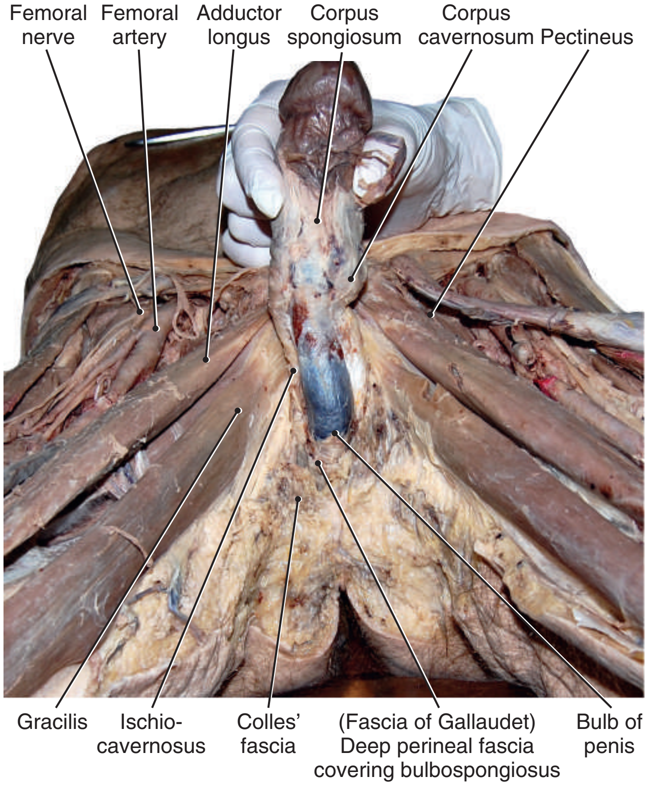

Femoral nerve
Femoral artery
Adductor longus
Corpus spongiosum
Corpus cavernosum
Pectineus
Gracilis
Ischio-cavernosus
Colles' fascia
(Fascia of Gallaudet) Deep perineal fascia covering bulbospongiosus
Bulb of penis

Fig. 15.8 Ischiocavernosus muscle arises from the ischiopubic rami.

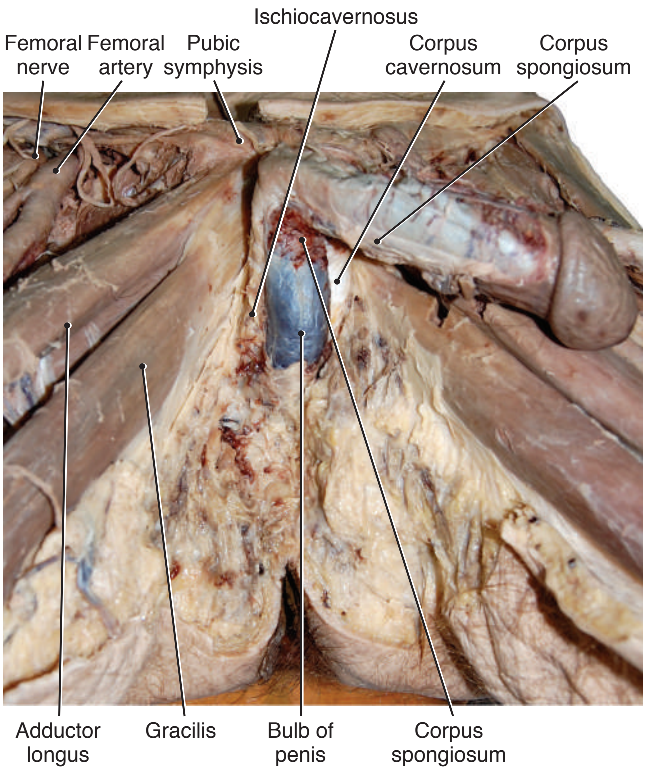

Ischiocavernosus
Femoral nerve
Femoral artery
Pubic symphysis
Corpus cavernosum
Corpus spongiosum
Adductor longus
Gracilis
Bulb of penis
Corpus spongiosum

Fig. 15.9 Crus of penis is surrounded by ischiocavernosus muscle.

- The inferior portion of the corpus spongiosum becomes dilated, forming the bulb of the penis. At the level of the bulb, remove the superficial perineal fascia and identify the superficial perineal muscle laterally (Figs. 15.10 and 15.11).

DISSECTION TIP

The superficial transverse perineal muscle is absent in some cadavers. It also has been shown that these muscles atrophy with age.

- Clean the superficial transverse perineal muscles, and superior to them, expose the perineal membrane (Fig. 15.12).
- Inferior and lateral to the transverse perineal muscles, expose the perineal nerve and perineal artery, which are branches of the pudendal nerve and internal pudendal artery, respectively (see Figs. 15.11 and 15.12).
- Expose the ischiocavernosus muscle along the ischiopubic rami (Fig. 15.13).
- Lift the penis and expose the crus. Make an incision into the crus and expose its spongy matrix and its *tunica albuginea*, the outer covering of the corpus (Fig. 15.14). Observe the pubic symphysis for the *suspensory ligament* of the penis, arising from deep fascia of the anterior abdominal wall, and the *fundiform ligament*, arising from the membranous layer of the superficial fascia of the abdomen.

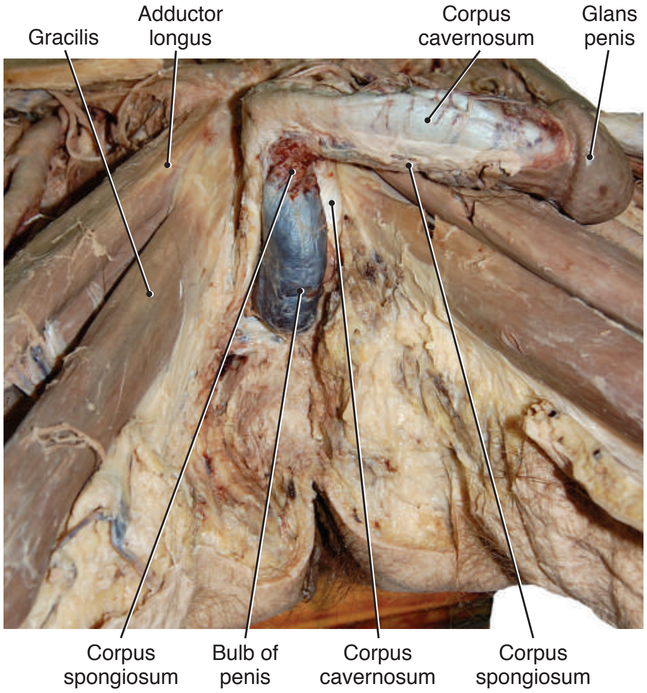

Gracilis
Adductor longus
Corpus cavernosum
Glans penis
Corpus spongiosum
Bulb of penis
Corpus cavernosum
Corpus spongiosum

Fig. 15.10 Dilated corpus spongiosum forms the bulb of penis.

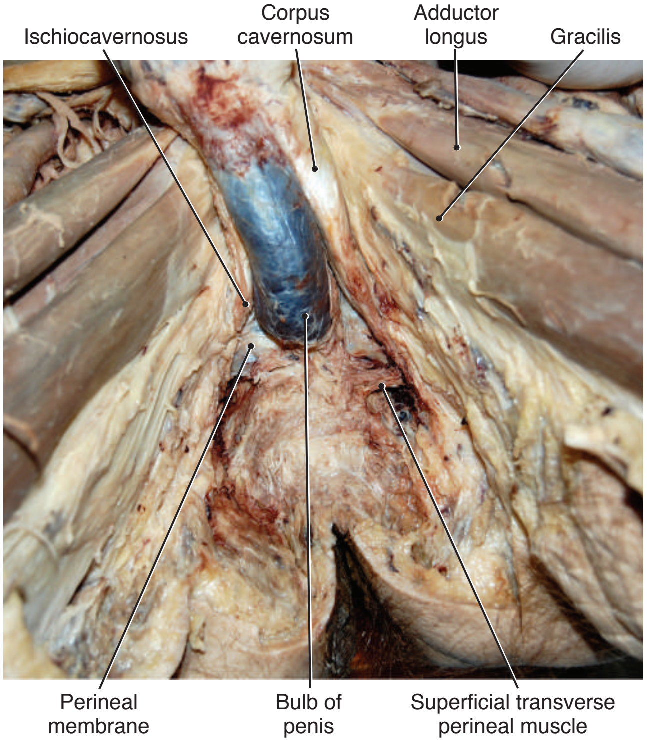
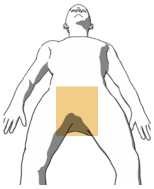

Ischiocavernosus
Corpus cavernosum
Adductor longus
Gracilis
Perineal membrane
Bulb of penis
Superficial transverse perineal muscle

Fig. 15.11 Superficial fascia removed at level of penile bulb to identify the superficial perineal muscle laterally.



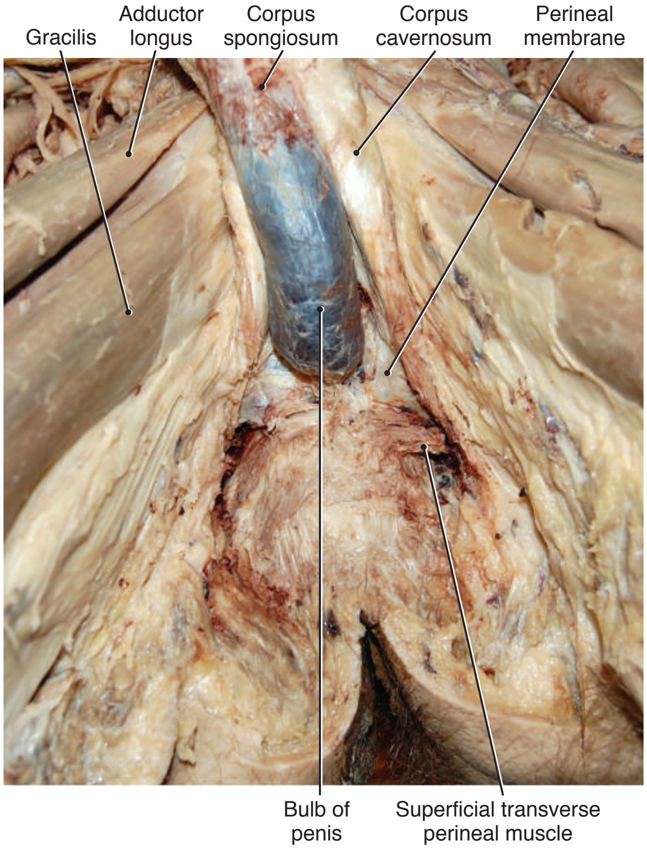
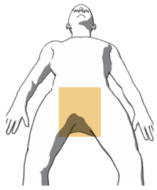

Gracilis
Adductor longus
Corpus spongiosum
Corpus cavernosum
Perineal membrane
Bulb of penis
Superficial transverse perineal muscle

Fig. 15.12 Superficial transverse perineal muscles cleaned, exposing perineal membrane. Perineal nerve and artery are inferior and lateral to the transverse perineal muscle.



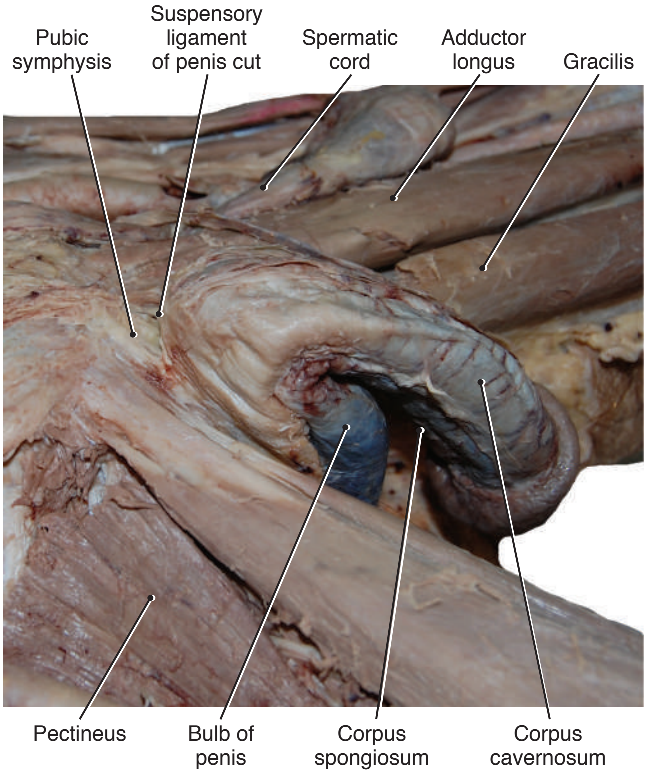

Pubic symphysis
Suspensory ligament of penis cut
Spermatic cord
Adductor longus
Gracilis
Pectineus
Bulb of penis
Corpus spongiosum
Corpus cavernosum

Fig. 15.13 Ischiocavernosus muscle along ischiopubic rami.

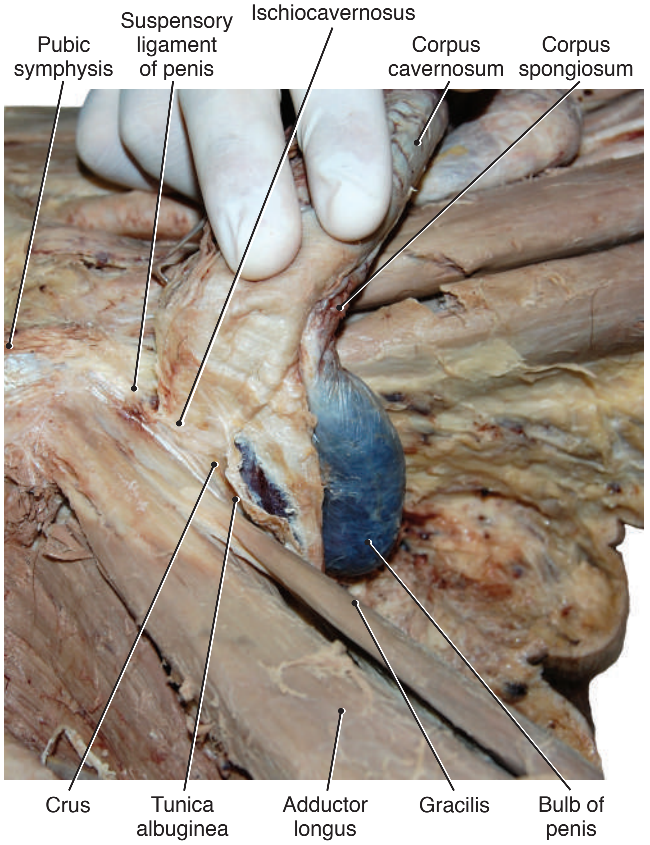

Pubic symphysis
Suspensory ligament of penis
Ischiocavernosus
Corpus cavernosum
Corpus spongiosum
Crus
Tunica albuginea
Adductor longus
Gracilis
Bulb of penis

Fig. 15.14 Penis lifted to expose crus with incision revealing spongy matrix and tunica albuginea.

- Cut the ischiocavernosus muscle and reflect it anteriorly to expose the perineal membrane (Fig. 15.15).

DISSECTION **TIP**

The bulbourethral gland in males may be difficult to find in the urogenital diaphragm.

- Cut the suspensory and fundiform ligaments of the penis and push the penis downward (Fig. 15.16).
- With a scalpel, cut through the bulb of the penis at the perineal membrane and remove the penis (Fig. 15.17).
- Identify the deep dorsal vein of the penis, the urethra, and the perineal body, and appreciate the dimensions of the perineal membrane.

ANATOMY **NOTE**

The deep dorsal vein of the penis is a large vein located deep to Buck's fascia (of the penis) just inferior to the arcuate pubic ligament. The deep dorsal vein anastomoses with the internal pudendal veins through the prostatic venous plexus.

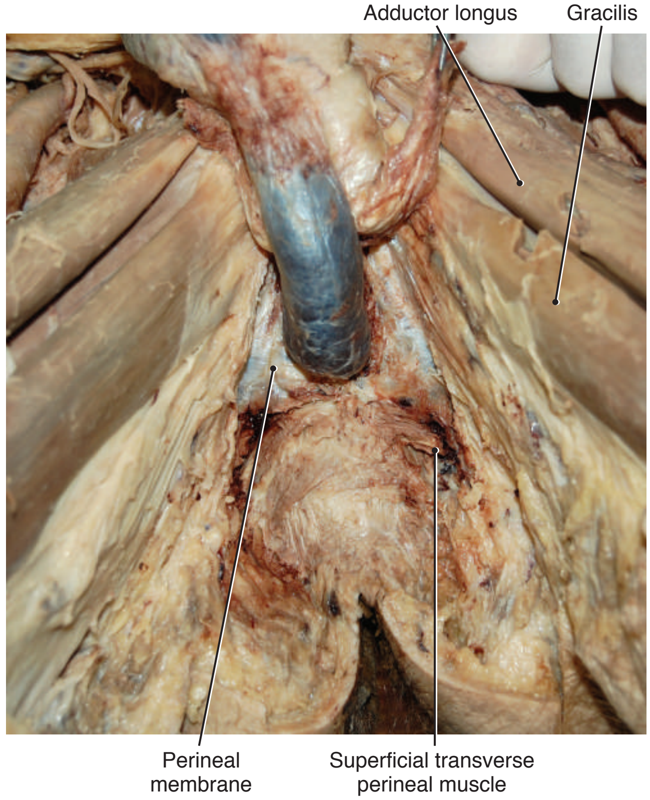
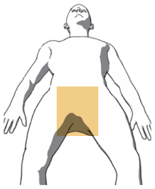

Adductor longus
Gracilis
Perineal membrane
Superficial transverse perineal muscle

Fig. 15.15 Ischiocavernosus muscle reflected anteriorly to expose the perineal membrane.



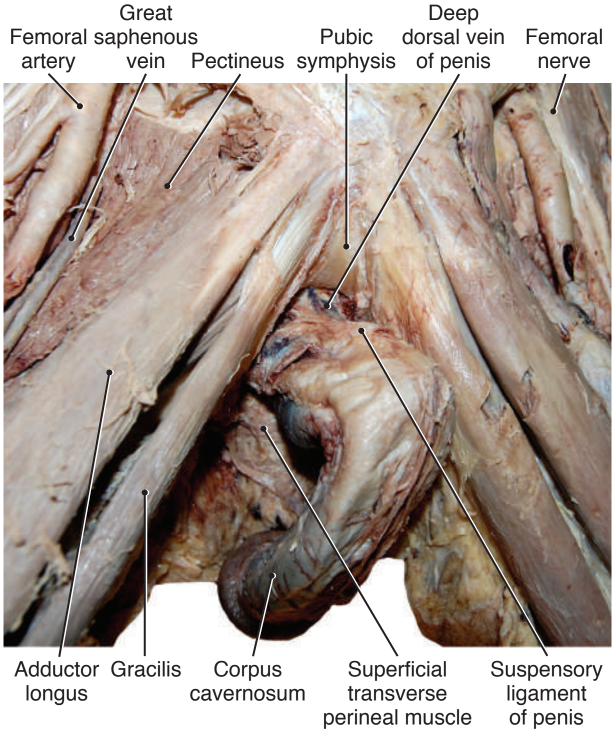

Femoral artery
Great saphenous vein
Pectineus
Pubic symphysis
Deep dorsal vein of penis
Femoral nerve
Adductor longus
Gracilis
Corpus cavernosum
Superficial transverse perineal muscle
Suspensory ligament of penis

Fig. 15.16 Suspensory and fundiform ligaments cut and penis pushed downward.

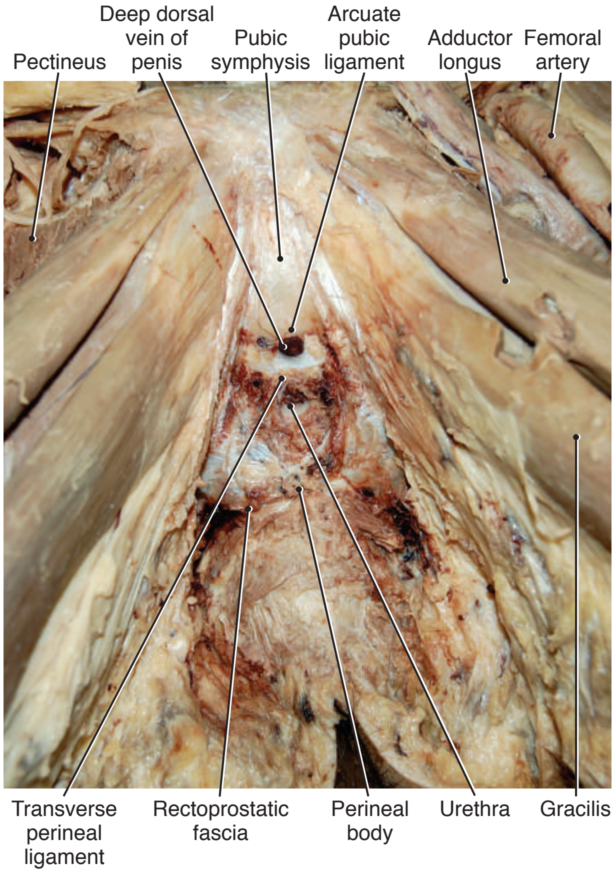
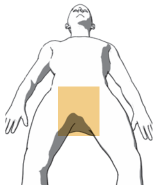

Deep dorsal vein of penis
Pectineus
Pubic symphysis
Arcuate pubic ligament
Adductor longus
Femoral artery
Transverse perineal ligament
Rectoprostatic fascia
Perineal body
Urethra
Gracilis

Fig. 15.17 Bulb cut from perineal membrane and penis removed revealing deep dorsal vein, urethra, and perineal body.



○ **Palpate the perineal membrane between the deep dorsal vein of the penis and the urethra, and note its thickening, the *transverse perineal ligament* (see Fig. 15.17).**

DISSECTION **TIP**

Inferior and lateral to the superficial transverse perineal muscle, locate the perineal nerve and the perineal artery, tracing these toward the ischioanal fossa if time permits.

○ **Reflect the deep perineal membrane, and expose the underlying musculature, the deep transverse perineal muscle and sphincter urethrae (Fig. 15.18).**

DISSECTION **TIP**

If time permits, cut the external urethral orifice of the penis and open the corpus spongiosum to expose the urethra. Extend the incision throughout the entire course of the urethra.

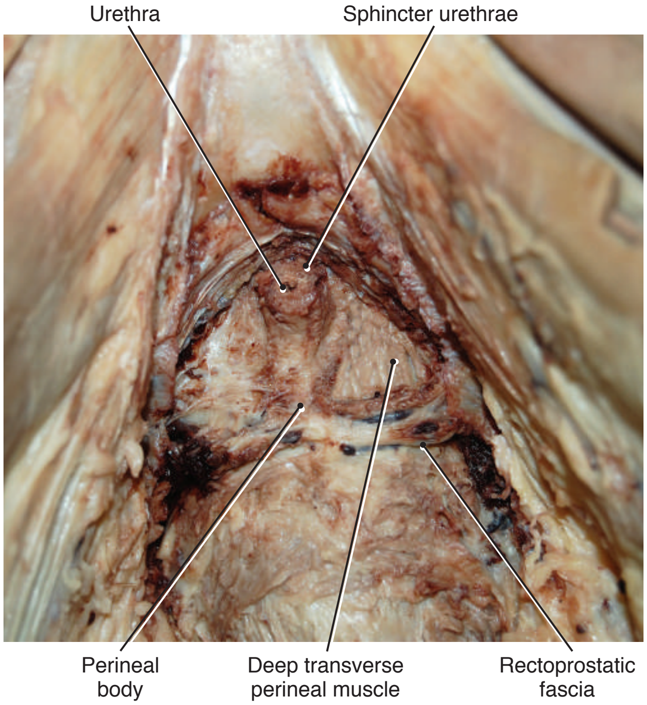
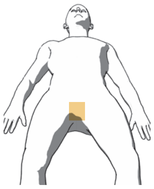

Urethra
Sphincter urethrae
Perineal body
Deep transverse perineal muscle
Rectoprostatic fascia

Fig. 15.18 Deep perineal membrane reflected, exposing underlying musculature, deep transverse perineal muscle, and sphincter urethrae.



DISSECTION OF THE FEMALE CADAVER

With the female cadaver in the supine position, identify the following structures (Figs. 15.19 and 15.20):

○ **Anterior commissure of labia majora**
○ **Labia majora**
○ **Labia minora**
○ **Glans of clitoris**
○ **Vaginal orifice**
○ **Vestibular fossa**
○ **Posterior commissure of labia major**
○ **Make an incision into the skin around the vaginal orifice, leaving the labia minora and clitoris intact. Incise the skin following the medial surface of the labia majora to the anterior commissure of the labia majora. Reflect the skin laterally and detach along the medial thigh (Figs. 15.21 and 15.22).**

ANATOMY **NOTE**

There are two layers that make up the superficial perineal fascia: a fatty superficial layer and a membranous deep layer (Colles' fascia). The fatty layer gives shape to the labia majora. The membranous layer of the superficial perineal fascia is attached to the ischiopubic ramus and the perineal membrane.

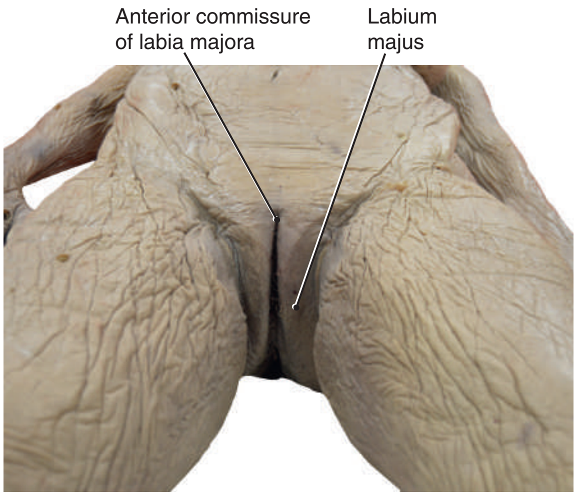
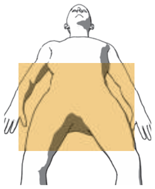

Anterior commissure of labia majora
Labium majus

Fig. 15.19 Female cadaver in supine position.



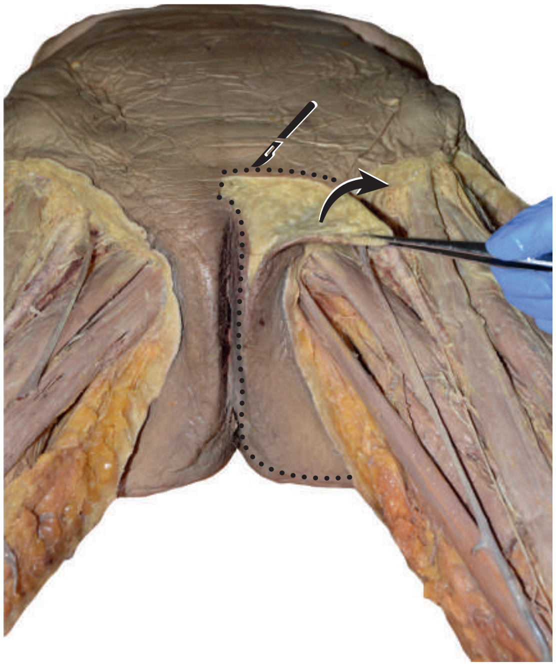
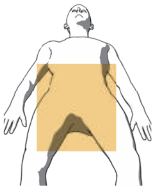


Fig. 15.21 *Dotted lines* demarcating the incision points and reflection of the skin laterally.



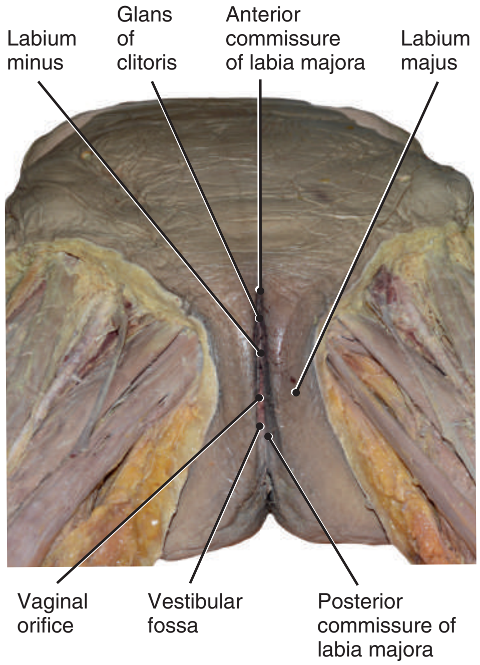
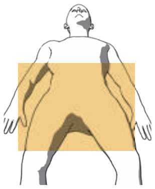

Labium minus
Glans of clitoris
Anterior commissure of labia majora
Labium majus
Vaginal orifice
Vestibular fossa
Posterior commissure of labia majora

Fig. 15.20 Female cadaver in supine position.



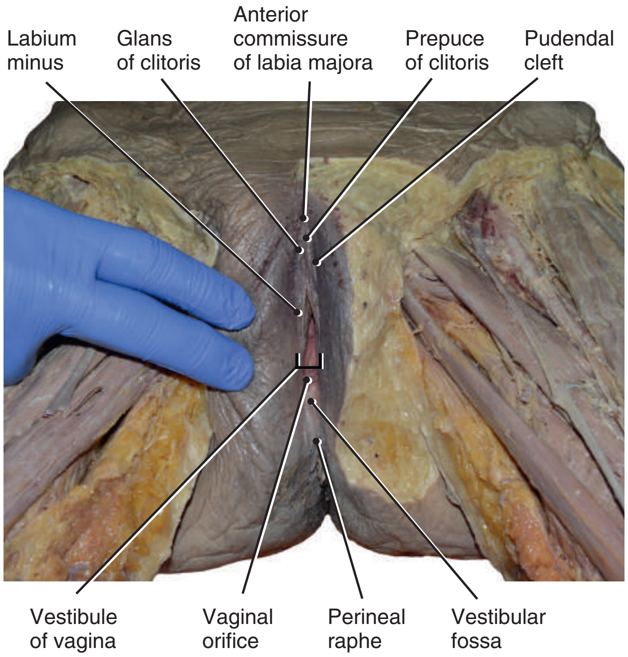
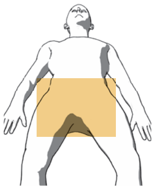

Labium minus
Glans of clitoris
Anterior commissure of labia majora
Prepuce of clitoris
Pudendal cleft
Vestibule of vagina
Vaginal orifice
Perineal raphe
Vestibular fossa

Fig. 15.22 Female cadaver in supine position, exposing the external genitalia.



DISSECTION TIP

Remnants of the round ligament of the uterus may be found as the removal of the superficial fascia is taking place, typically in younger cadavers.

- Remove the superficial fatty layer of the superficial perineal fascia to expose the superficial perineal (Colles') fascia and the fat of the ischioanal fossa (Fig. 15.23).
- Cut open the superficial perineal fascia to reveal the deep perineal (investing or Gallaudet's) fascia. This fascia covers the bulbospongiosus muscle located lateral to the labia minora (Fig. 15.24 and Plate 15.2).
- Identify the bulbospongiosus muscle. Dissect lateral to the bulbospongiosus muscle to identify the ischiocavernosus muscle running along the ischiopubic ramus. Use blunt dissection to locate the deep and superficial branches of the perineal artery, vein, and nerve (Fig. 15.25).

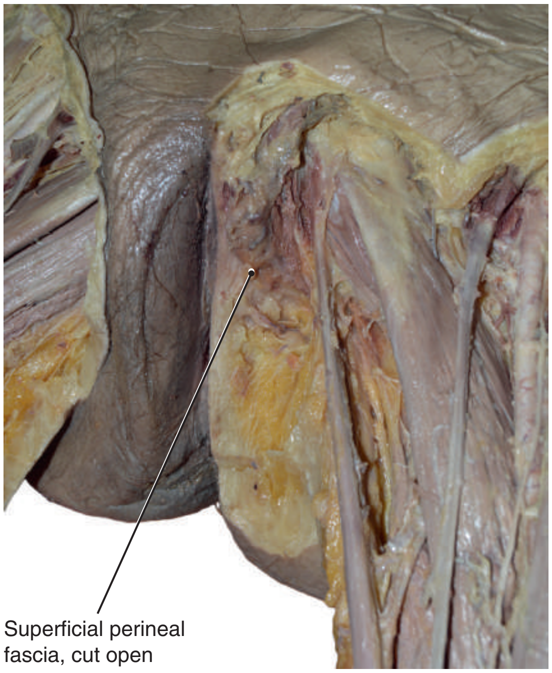
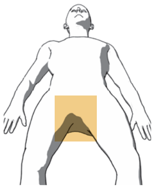

Superficial perineal
fascia, cut open

Fig. 15.24 Superficial perineal (Colles') fascia cut open.



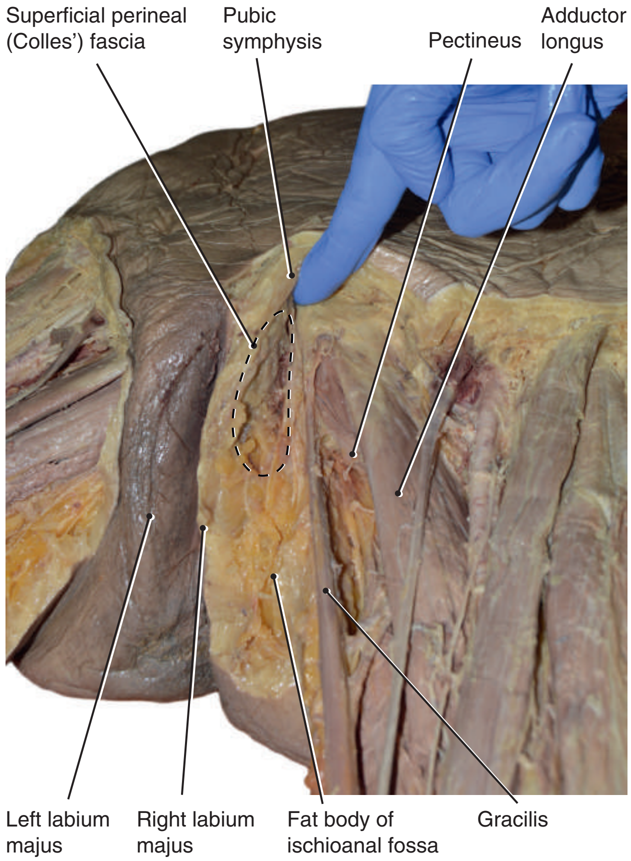
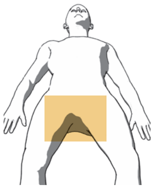

Superficial perineal (Colles') fascia
Pubic symphysis
Pectineus
Adductor longus
Left labium majus
Right labium majus
Fat body of ischioanal fossa
Gracilis

Fig. 15.23 Superficial perineal (Colles') fascia exposed, as well as the musculature of the left thigh.



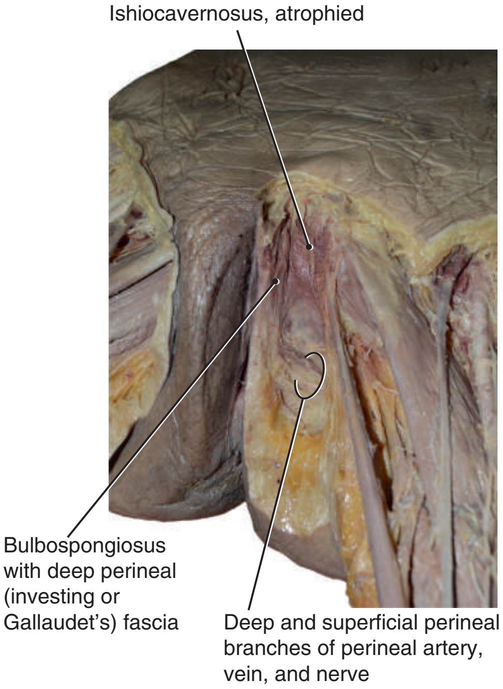
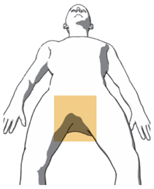
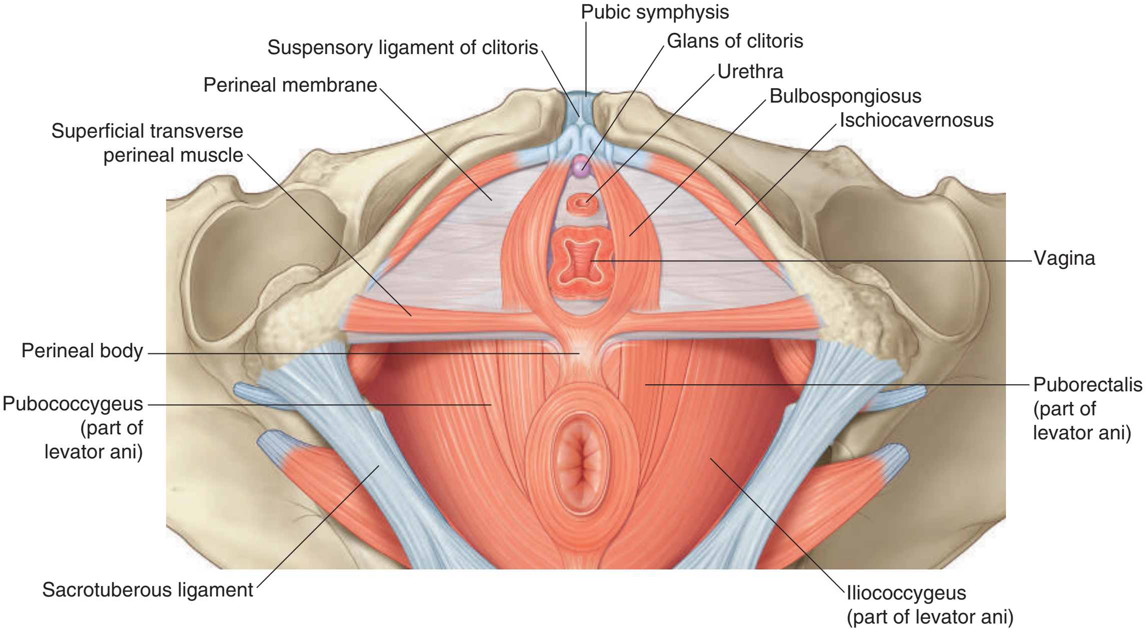
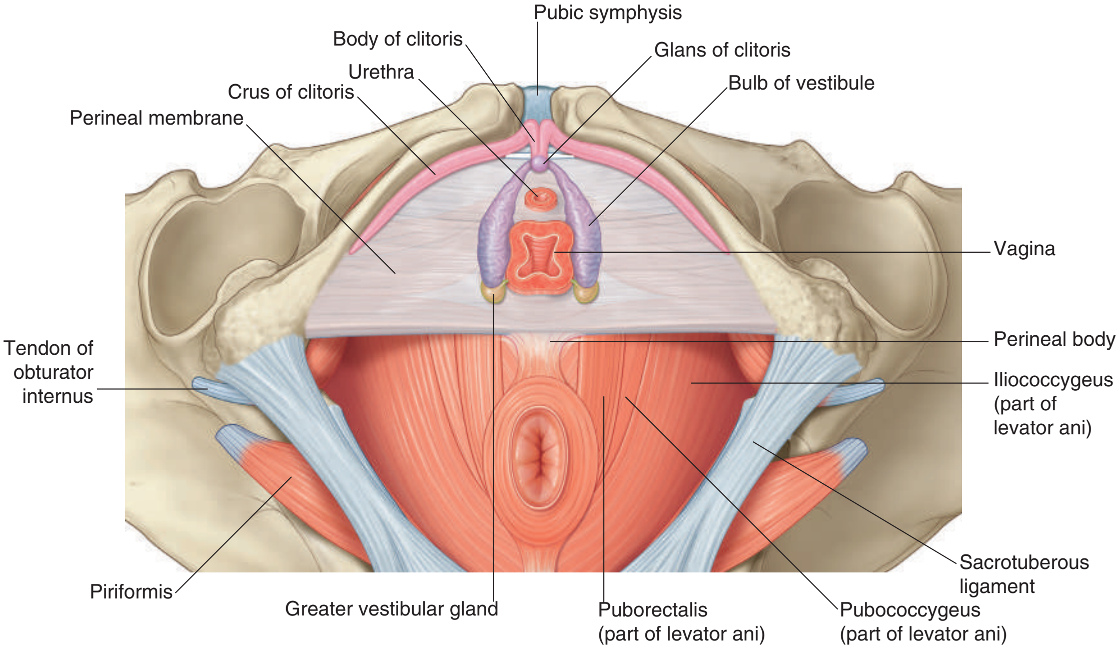

Ishiocavernosus, atrophied
Bulbospongiosus with deep perineal (investing or Gallaudet's) fascia
Deep and superficial perineal branches of perineal artery, vein, and nerve

Fig. 15.25 Bulbospongiosus and deep perineal fascia exposed, as well as superficial and deep branches of perineal artery, vein, and nerve.




Pubic symphysis
Suspensory ligament of clitoris
Glans of clitoris
Urethra
Perineal membrane
Bulbospongiosus
Ischiocavernosus
Superficial transverse perineal muscle
Vagina
Perineal body
Puborectalis (part of levator ani)
Pubococcygeus (part of levator ani)
Sacrotuberous ligament
Iliococcygeus (part of levator ani)

Muscles of the superficial perineal pouch in women


Pubic symphysis
Body of clitoris
Glans of clitoris
Urethra
Bulb of vestibule
Crus of clitoris
Perineal membrane
Vagina
Perineal body
Tendon of obturator internus
Iliococcygeus (part of levator ani)
Sacrotuberous ligament
Piriformis
Greater vestibular gland
Puborectalis (part of levator ani)
Pubococcygeus (part of levator ani)

Erectile tissues of the superficial perineal pouch in women

Plate 15.2 Muscles and erectile tissues of the superficial perineal pouch in females.

ANATOMY **NOTE**

The bulbospongiosus muscle attaches anteriorly to the corpus cavernosus clitoris and posteriorly to the perineal body. The bulbospongiosus muscle in the female is separate and does not attach in the midline as in males. The ischiocavernosus muscle covers the surface of the crus of the clitoris.

- Dissect further to reveal the crus of the clitoris. Clean the adipose tissue from the deep and superficial branches of the perineal artery, vein, and nerve (Fig. 15.26).
- Reflect the bulbospongiosus muscle laterally to reveal the bulb of the vestibule (Fig. 15.27).
- Cut the crus of the clitoris and reflect it laterally (Fig. 15.28).
- Identify the perineal membrane (Fig. 15.29).

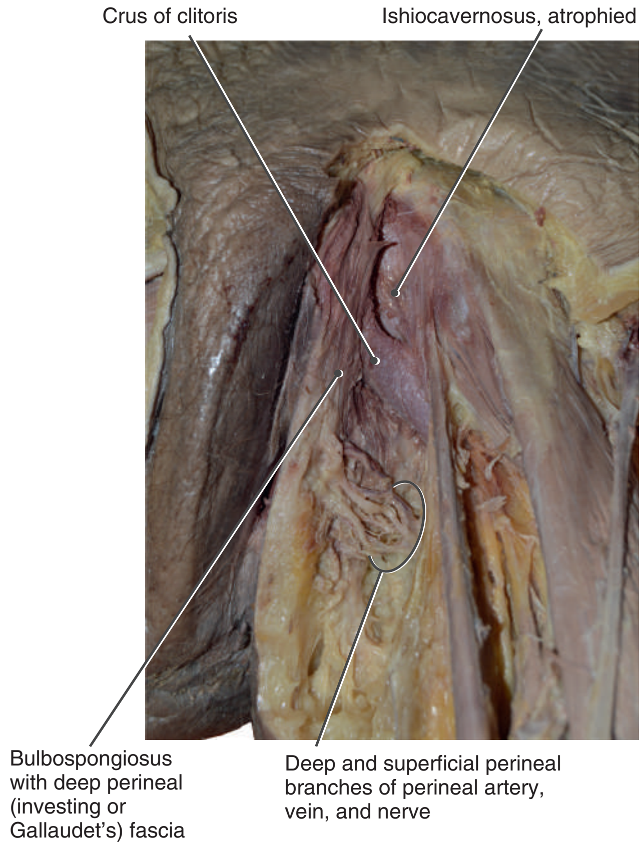
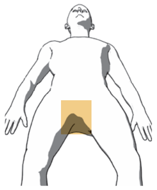

Crus of clitoris
Ishiocavernosus, atrophied
Bulbospongiosus with deep perineal (investing or Gallaudet's) fascia
Deep and superficial perineal branches of perineal artery, vein, and nerve

Fig. 15.26 Crus of clitoris exposed.



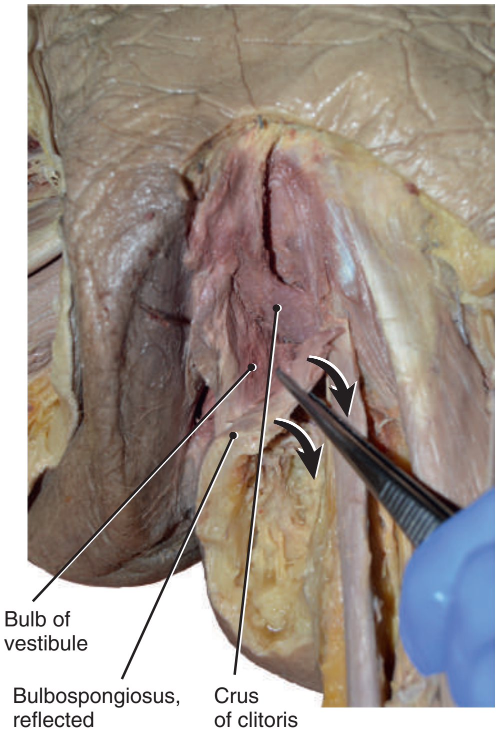
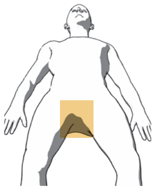

Bulb of vestibule
Bulbospongiosus, reflected
Crus of clitoris

Fig. 15.27 Bulbospongiosus reflected, exposing the bulb of vestibule.



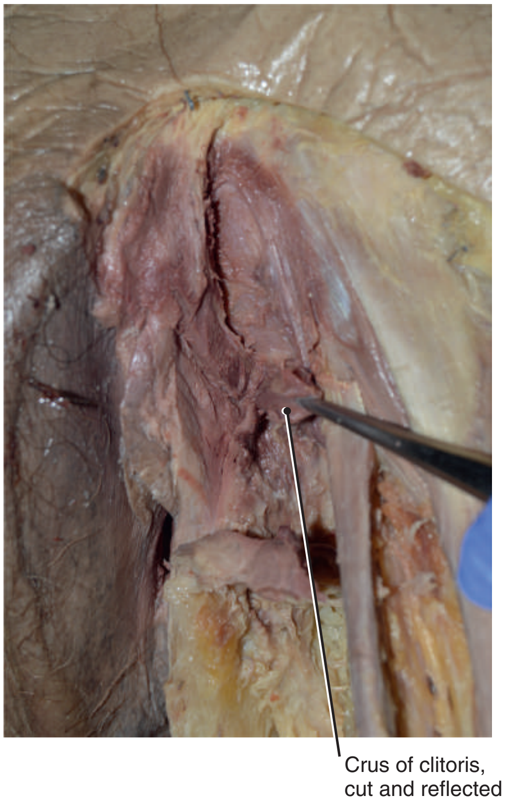
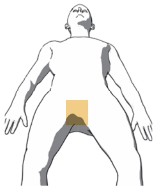

Crus of clitoris, cut and reflected

Fig. 15.28 Crus of clitoris cut and reflected.



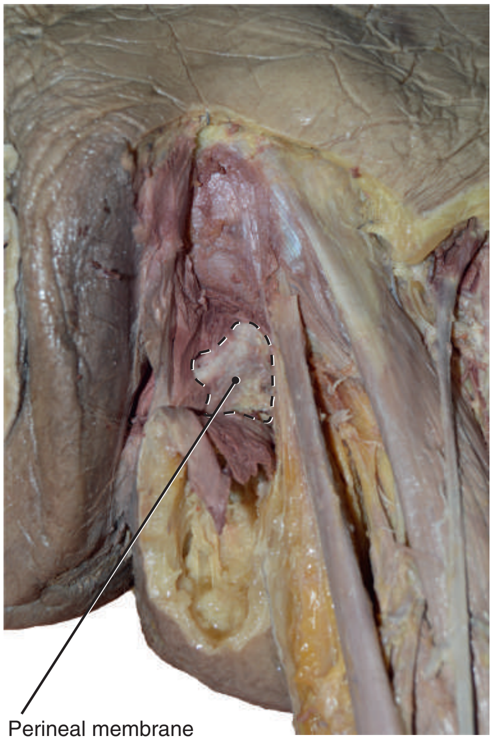
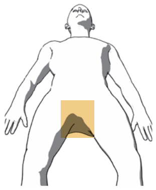

Perineal membrane

Fig. 15.29 Perineal membrane exposed.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Femoral
  - ☐ Motor branches
  - ☐ Cutaneous branches
- ☐ Obturator
  - ☐ Anterior branch
  - ☐ Posterior branch
- ☐ Ilioinguinal
- ☐ Pudendal

ARTERIES

- ☐ Femoral
- ☐ Obturator
- ☐ Deferential
- ☐ Perineal

VEINS

- ☐ Great saphenous
- ☐ Femoral
- ☐ Deep dorsal of penis

MUSCLES

- ☐ Sartorius
- ☐ Gracilis
- ☐ Adductor longus
- ☐ Pectineus
- ☐ Iliopsoas
- ☐ Bulbospongiosus
- ☐ Ischiocavernosus
- ☐ Superficial transverse perineus
- ☐ Deep transverse perineus
- ☐ Sphincter urethrae

CONNECTIVE TISSUE

- ☐ Superficial perineal fascia
- ☐ Corpora cavernosa
- ☐ Bulb of penis
- ☐ Bulb of vestibule
- ☐ Corpus spongiosum
- ☐ Crus of penis/clitoris
- ☐ Perineal membrane
- ☐ Perineal body
- ☐ Suspensory ligament of penis/clitoris
- ☐ Prepuce of penis/clitoris
- ☐ Glans of penis/clitoris
- ☐ Spermatic cord
- ☐ Scrotum
- ☐ Labia majora
- ☐ Labia minora
- ☐ Rectoprostatic fascia
- ☐ Pubic symphysis
- ☐ Anterior commissure of labia majora
- ☐ Glans of clitoris
- ☐ Vaginal orifice
- ☐ Vestibular fossa
- ☐ Posterior commissure of labia majora

BONES

- ☐ Right/left pubic bone
- ☐ Ischial spine

Clinical Application

Figs. VI.1 and VI.2 depict the pelvic cavity with viscera removed. Note the superior and inferior hypogastric plexuses.

Figs. VI.3 and VI.4 show large tumors in the uterus.

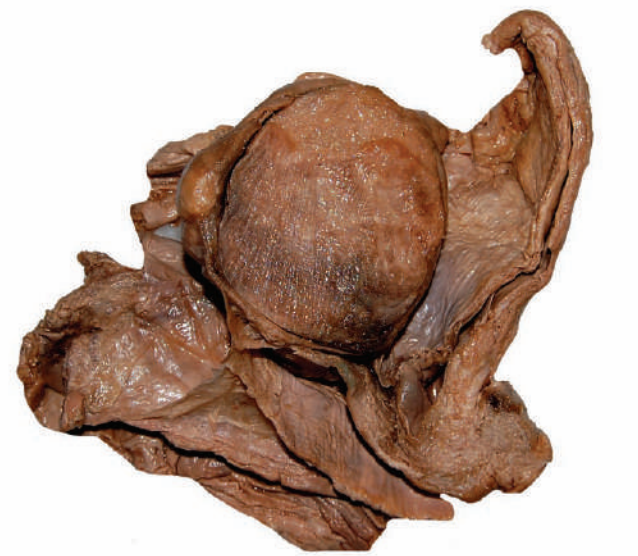


Fig. VI.3

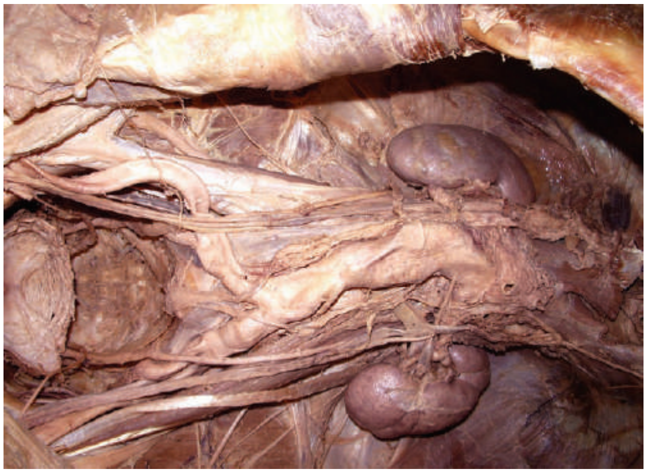


Fig. VI.1

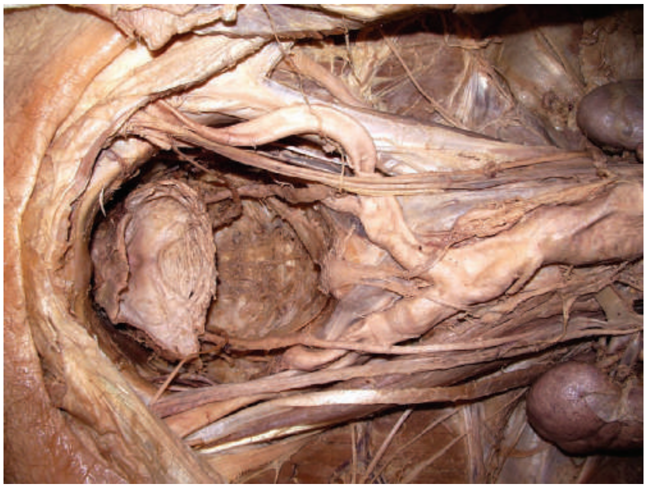


Fig. VI.2

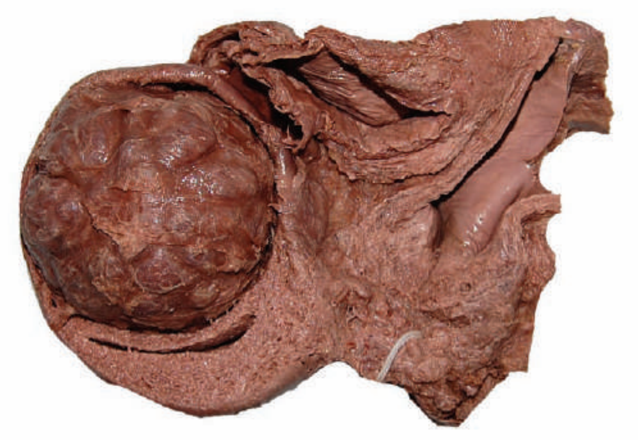


Fig. VI.4

CHAPTER 16 GLUTEAL REGION

ATLAS REFERENCES

Netter: 492–494
McMinn: 316–319
Gray's Atlas: 301–303, 307, 314, 315

BEFORE YOU BEGIN

Typically, you will not need to make additional skin incisions if you continue the dissection on the same cadaver on which you performed the dissection of the back in Chapter 2 (Fig. 16.1).

If not, place the cadaver in the prone position, and incise the skin and subcutaneous tissues along the iliac crest to the posterior superior iliac spine (Figs. 16.2 and 16.3).

Extend this incision medially to the intergluteal cleft, anterior to the area covering the perineum.

SKIN AND SUPERFICIAL FASCIA

- **Reflect the skin and superficial fascia from the gluteal region and posterior thigh by making a longitudinal midline skin incision distally to the knee. Make a circumferential incision through the skin of the leg, just distal to the knee (see Figs. 16.2 and 16.3).**
- **There is typically a large amount of adipose tissue over the gluteus maximus muscle. Remove the adipose tissue and deep fascia in the gluteal region, exposing the gluteus maximus muscle (Figs. 16.4 to 16.6).**

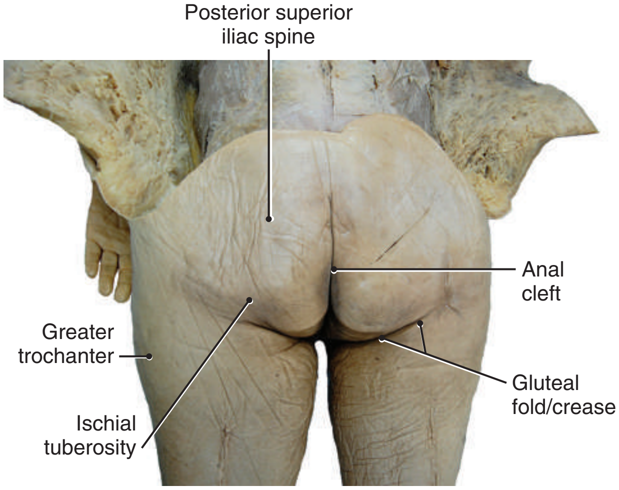

Posterior superior iliac spine
Anal cleft
Greater trochanter
Gluteal fold/crease
Ischial tuberosity

Fig. 16.1 Surface anatomy of the gluteal region.

DISSECTION **TIP**

In many atlases, you will find the gluteus maximus muscle shown with no fat. To create a clean specimen, remove the fat between the fibers of the gluteus maximus muscle (see Fig. 16.6).

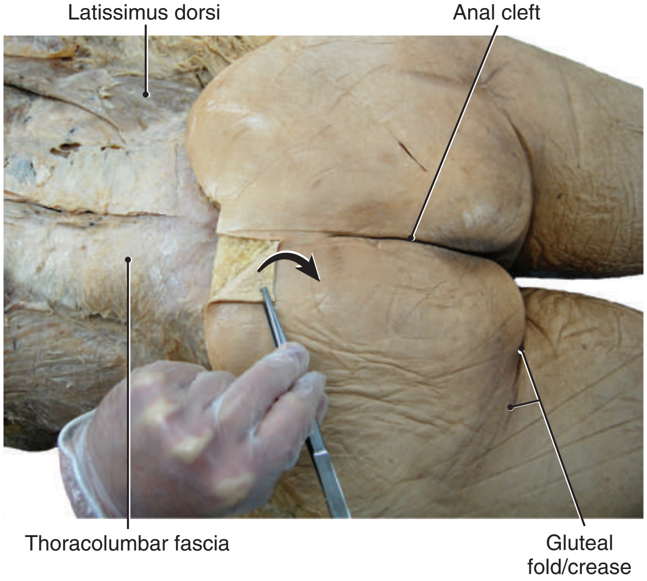

Latissimus dorsi
Anal cleft
Thoracolumbar fascia
Gluteal fold/crease

Fig. 16.2 Gluteal region with reflected skin, demonstrating dissection from the midline.

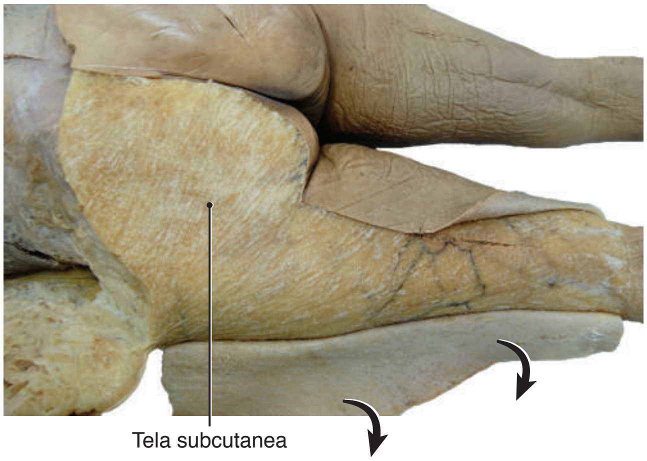
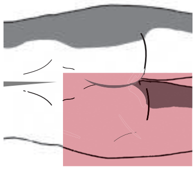

Tela subcutanea

Fig. 16.3 Gluteal and posterior thigh regions with dermis reflected, revealing membranous layer of subcutaneous tissue (tela subcutanea).



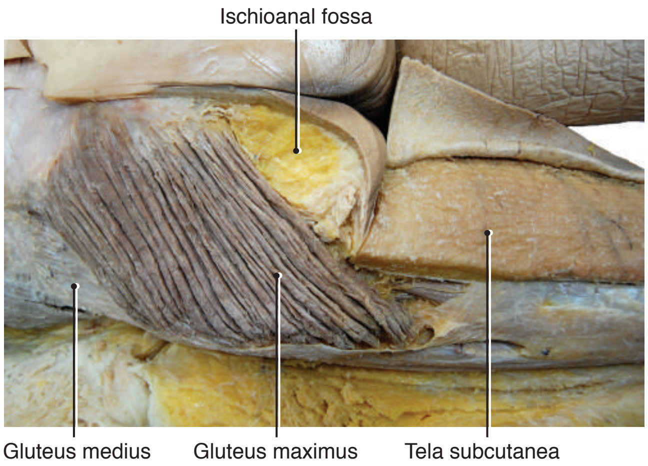
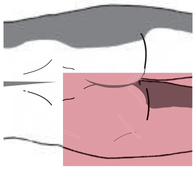

Ischioanal fossa
Gluteus medius
Gluteus maximus
Tela subcutanea

Fig. 16.5 Further gluteal region dissection, revealing the gluteus medius (covered with fascia) muscle superiorly, the gluteus maximus muscle inferiorly, and the ischioanal fossa and tela subcutanea medially.



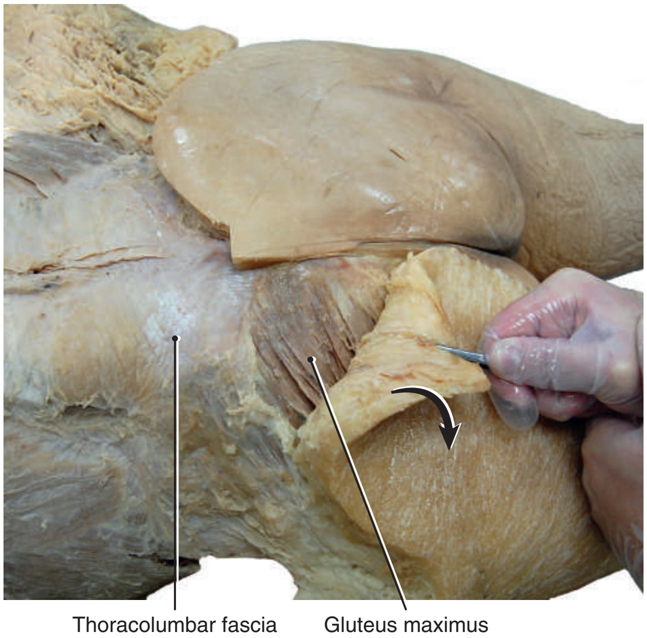
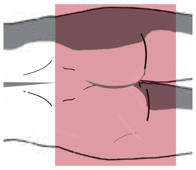

Thoracolumbar fascia
Gluteus maximus

Fig. 16.4 Gluteal region with thoracolumbar fascia superiorly and reflected subcutaneous tissue, revealing gluteus maximus muscle inferiorly.



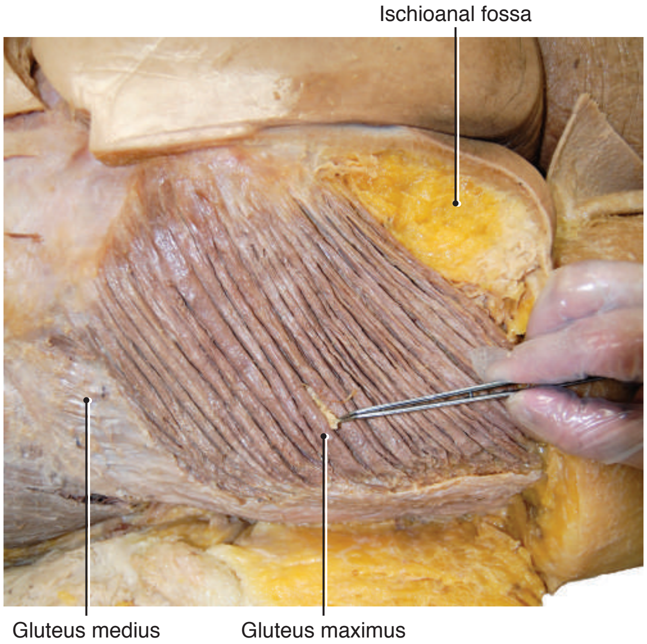
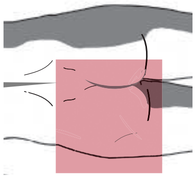

Ischioanal fossa
Gluteus medius
Gluteus maximus

Fig. 16.6 Closer view highlighting the gluteus medius (covered with fascia) muscle superiorly, the gluteus maximus muscle inferiorly, and the ischioanal fossa medially.



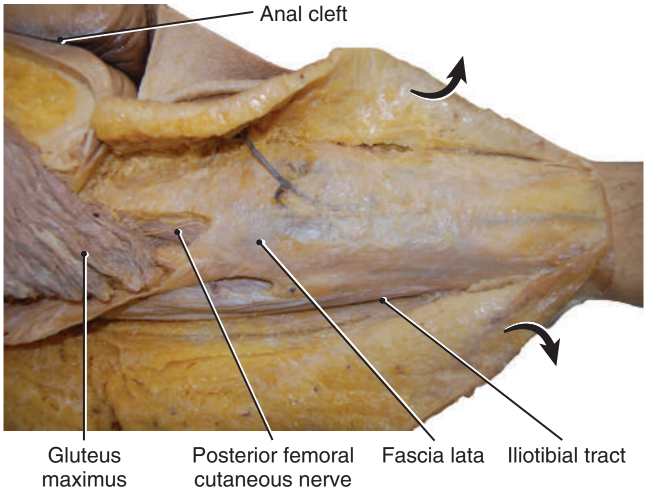
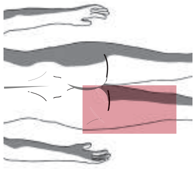


Fig. 16.7 Posterior thigh region with skin and subcutaneous tissue reflected, revealing the posterior cutaneous nerve, fascia lata, and iliotibial tract.



- Reflect the skin over the posterior portion of the thigh. The adipose tissue and deep fascia will be removed later during the dissection (Fig. 16.7).

DISSECTION **TIP**

As you delineate the superior and inferior borders of the gluteus maximus muscle, protect the posterior femoral cutaneous nerve from damage by being cautious along the inferior border of the gluteus maximus muscle.

SUPERFICIAL MUSCLES

- Palpate the sacrotuberous ligament at the medial border of the gluteus maximus muscle by placing your fingertips into the ischioanal fossa (Fig. 16.8).
- Palpate the superior border of the gluteus maximus and insert your fingertips into the space between the gluteus maximus muscle and fascia over the gluteus medius muscle (Fig. 16.9).
- Using your fingertips, lift the upper portion of the gluteus maximus muscle from the underlying gluteus medius muscle.

DISSECTION **TIP**

In most cadavers, the deep fascia and aponeurotic tissues along the superior border of the gluteus maximus muscle blend with those of the gluteus medius muscle. However, the muscular fibers of the gluteus medius muscle run almost perpendicular to the orientation of the gluteus maximus muscle, and the two muscles can be separated readily once you have clearly exposed their fibers.

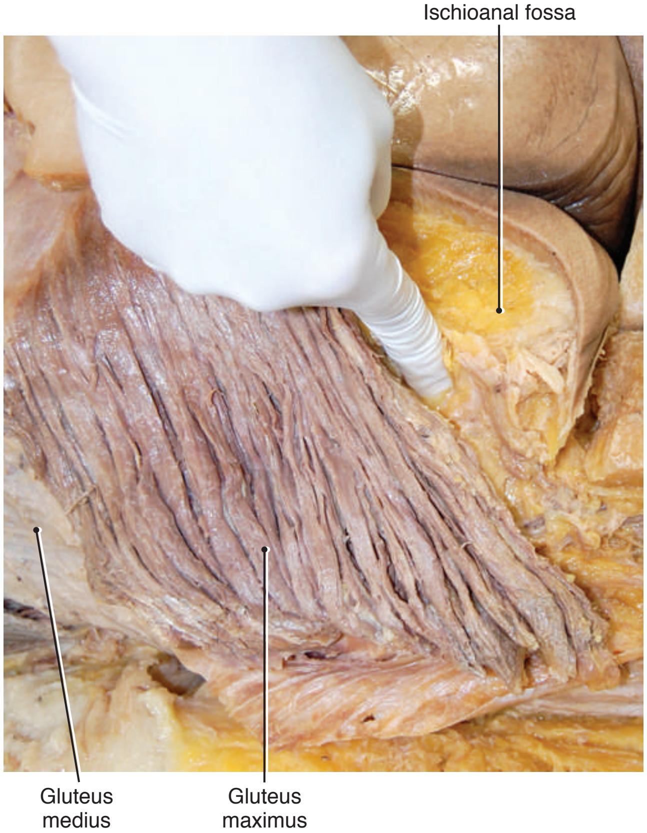
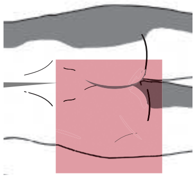


Fig. 16.8 Fingertips in gluteal region highlight gluteus medius superiorly, gluteus maximus inferiorly, and ischioanal fossa medially (palpation of lateral wall of fossa–obturator internus).



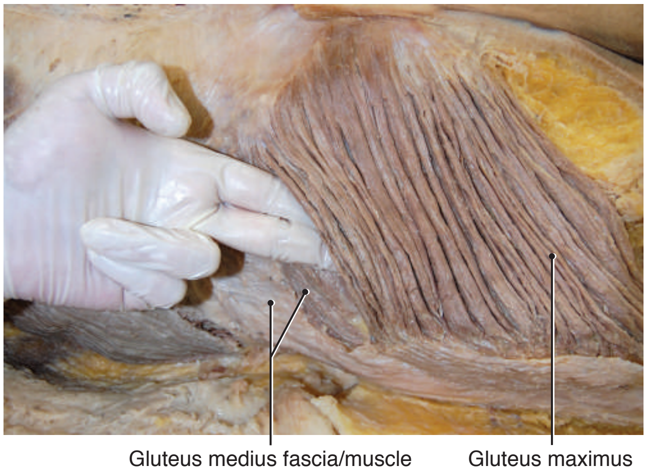
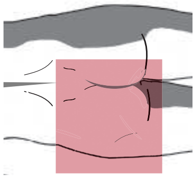


Fig. 16.9 Gluteal region after dissecting superior border of gluteus maximus muscle superficially, revealing deeper gluteus medius fascia and muscle.



DEEP DISSECTION

- Make an incision at the lateral border of the gluteus maximus muscle, separating it from its connection to the iliotibial tract (Fig. 16.10).
- Lift the gluteus maximus medially toward the sacrum, and identify the greater trochanter and overlying trochanteric bursa (Figs. 16.11 and 16.12).

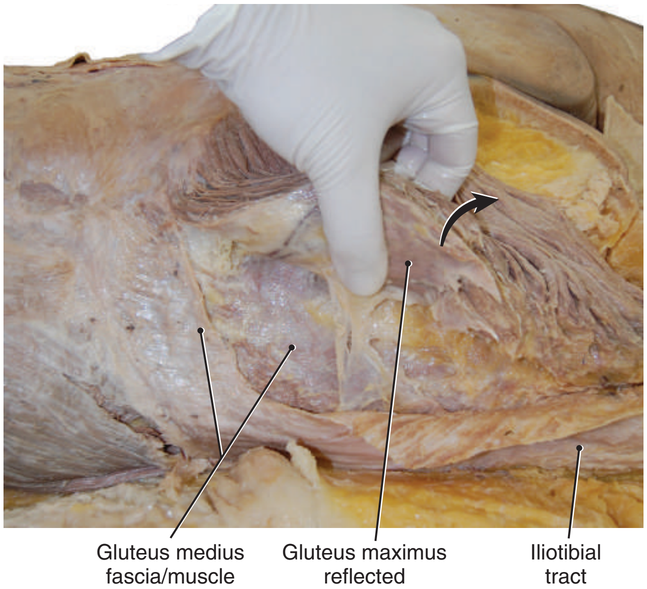
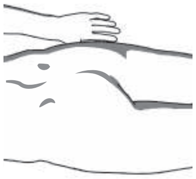

Gluteus medius fascia/muscle
Gluteus maximus reflected
Iliotibial tract

Fig. 16.10 Reflecting the gluteus maximus muscle demonstrates the deeper lying muscle fibers of the gluteus medius muscle.



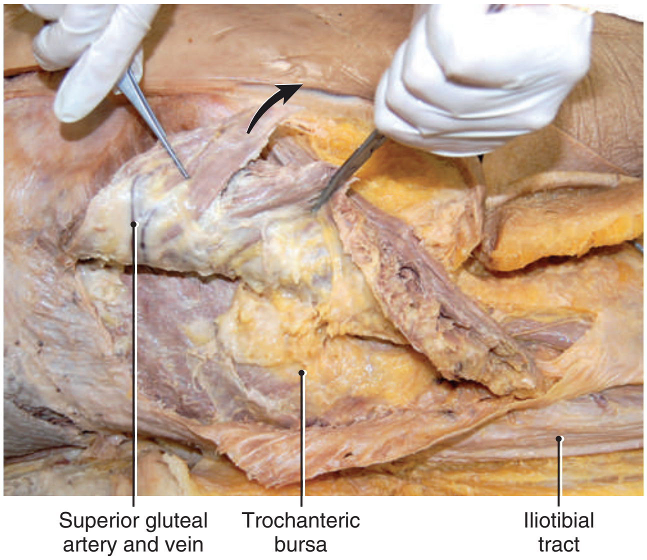
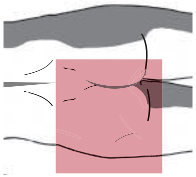

Superior gluteal artery and vein
Trochanteric bursa
Iliotibial tract

Fig. 16.11 Reflection of superolateral border of gluteus maximus muscle, revealing superior gluteal artery and vein and trochanteric bursa.



DISSECTION TIP

The trochanteric bursa appears as loose connective tissue over the greater trochanter, intermingled with adipose tissue. It often is cleaned away during routine dissection.

- Reflect the gluteus maximus muscle medially from the gluteal tuberosity of the femur; remove the deep fascia and adipose tissue along its inferior border (Fig. 16.13).
- Clean the sciatic and the posterior femoral cutaneous nerves from the adipose tissue, and trace them proximally from under the piriformis muscle (Fig. 16.14). Once you identify the posterior femoral cutaneous nerve, identify its perineal branch traveling medially.

DISSECTION TIP

To identify the posterior femoral cutaneous nerve, make a small opening through the fascia lata on the posterior aspect of the thigh, and identify the sciatic nerve. Medial to the sciatic nerve, you will be able to identify the posterior femoral cutaneous nerve. In some specimens, the sciatic nerve may split in the gluteal region, with one part traveling above or through and the other part below the piriformis muscle.

- The gluteus maximus muscle is partially attached to the sacrotuberous ligament. Palpate the sacrotuberous

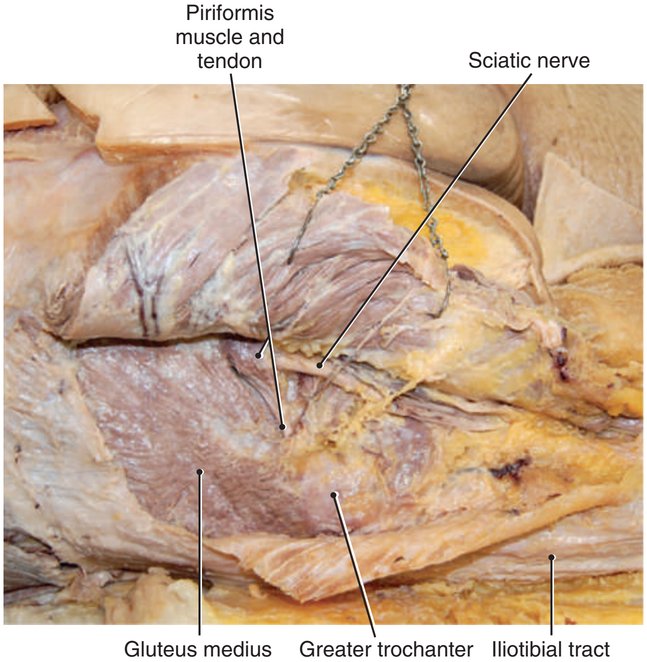
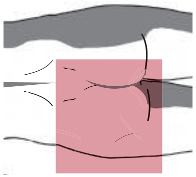
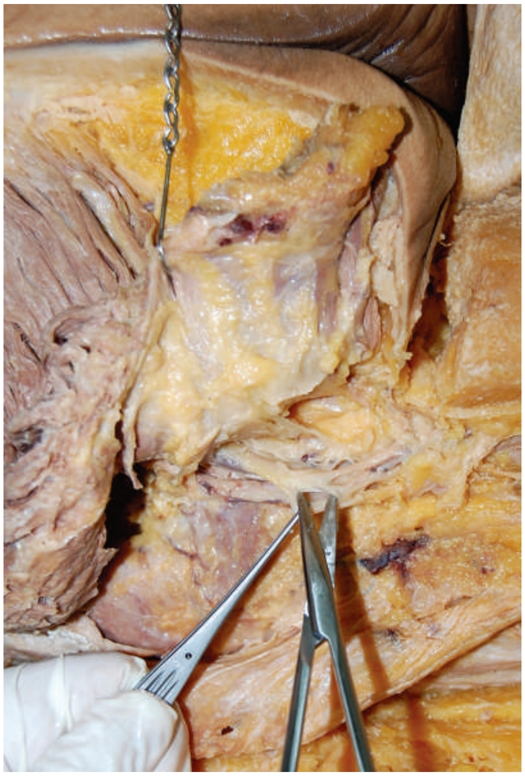

Piriformis muscle and tendon
Sciatic nerve
Gluteus medius
Greater trochanter
Iliotibial tract

Fig. 16.12 Gluteal region with reflected gluteus maximus muscle, revealing gluteus medius and piriformis muscles and sciatic nerve.





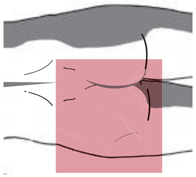
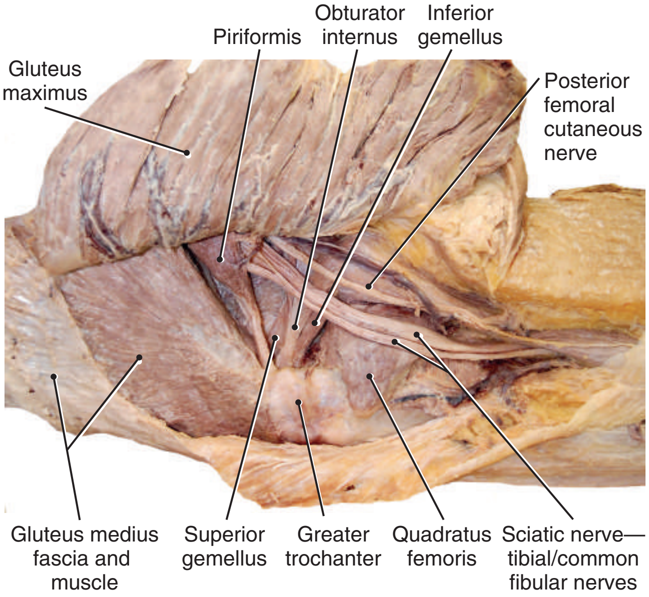


Fig. 16.13 Connective tissue cleaned around posterior femoral cutaneous and sciatic nerves.


Gluteus maximus
Piriformis
Obturator internus
Inferior gemellus
Posterior femoral cutaneous nerve
Gluteus medius fascia and muscle
Superior gemellus
Greater trochanter
Quadratus femoris
Sciatic nerve—tibial/common fibular nerves

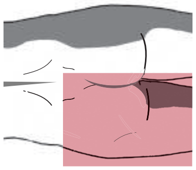
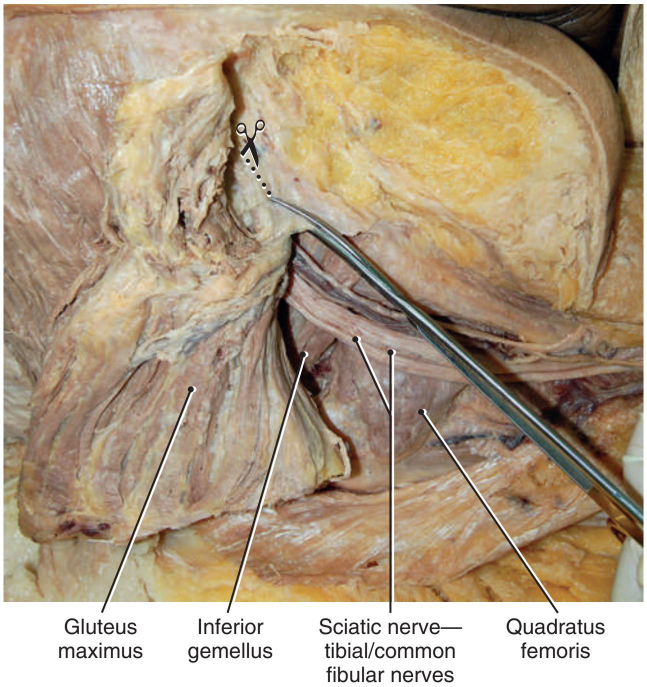


Fig. 16.14 Reflected gluteus maximus muscle, revealing gluteus medius, rotator muscles (piriformis, superior/inferior gemelli, obturator internus, quadratus femoris), sciatic nerve, and posterior femoral cutaneous nerve.


Gluteus maximus
Inferior gemellus
Sciatic nerve—tibial/common fibular nerves
Quadratus femoris

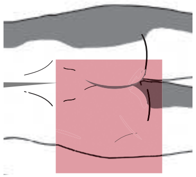


Fig. 16.15 Reflected gluteus maximus muscle revealing quadratus femoris muscle and tibial and common fibular nerves.

ligament as you did earlier (see Fig. 16.8); reflect the gluteus maximus muscle medially toward the sacrum, and expose the sacrotuberous ligament.

- **Use a scalpel to cut the attachment of the gluteus maximus muscle from the sacrotuberous ligament. With scissors, cut the lateral portion of the sacrotuberous ligament, and free the gluteus maximus muscle (Fig. 16.15).**
- **Clean and expose the inferior gluteal vessels and nerve from the deep surface of the gluteus maximus muscle (Figs. 16.16 and 16.17).**
- **Lift the posterior femoral cutaneous and sciatic nerves, and clean the adipose and connective tissues from the structures that lie deep to the gluteus maximus muscle, such as the piriformis, obturator internus, and superior and inferior gemellus muscles (Figs. 16.18 and 16.19).**
- **Inferior to the obturator internus and gemelli muscles, identify the quadratus femoris muscle.**

DISSECTION **TIP**

The obturator internus, superior gemellus, and inferior gemellus muscles often are seen as a combined tripartite tendon with indistinguishable borders. With scissors or a probe, separate these three muscles at the margin of the lesser sciatic foramen.

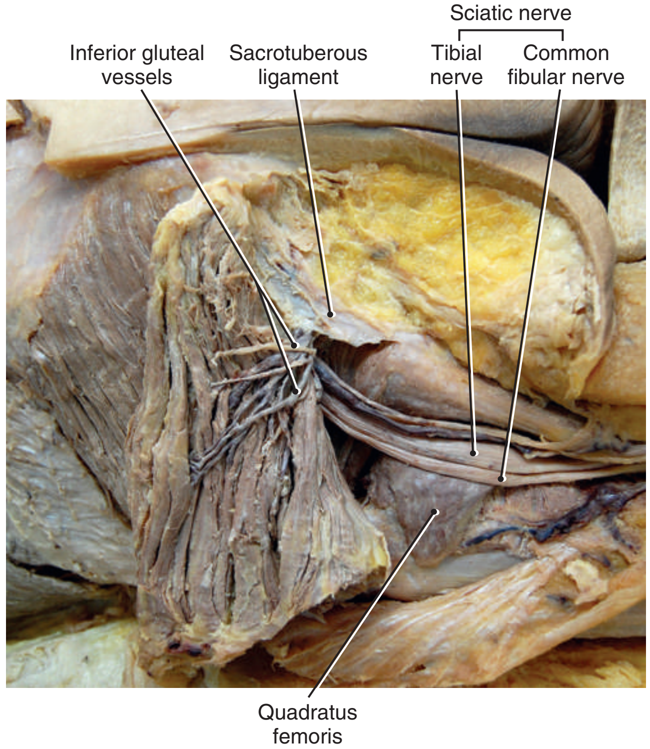
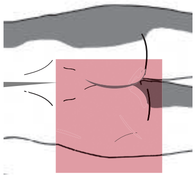

Sciatic nerve
Inferior gluteal vessels
Sacrotuberous ligament
Tibial nerve
Common fibular nerve
Quadratus femoris

Fig. 16.16 Gluteus maximus muscle reflected superiorly, revealing inferior gluteal vessels, quadratus femoris muscle, and tibial and common fibular nerves.



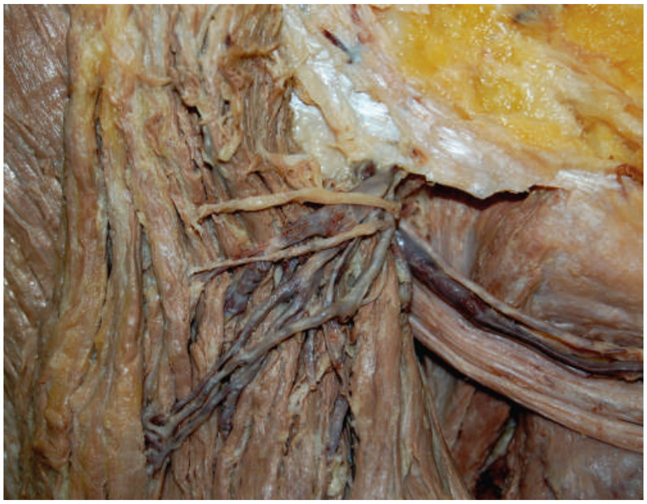
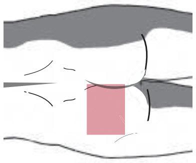


Fig. 16.17 Closer view of Fig. 16.16 showing gluteal region with gluteus maximus reflected, revealing inferior gluteal artery and vein and sacrotuberous ligament.



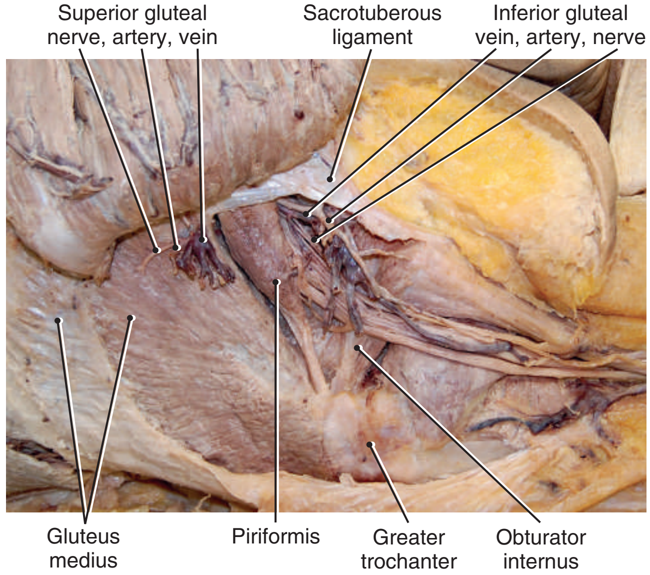
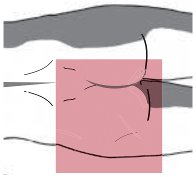

Superior gluteal nerve, artery, vein
Sacrotuberous ligament
Inferior gluteal vein, artery, nerve
Gluteus medius
Piriformis
Greater trochanter
Obturator internus

Fig. 16.18 Gluteal region with gluteus maximus reflected, revealing superior and inferior gluteal artery and vein oriented around piriformis muscle.



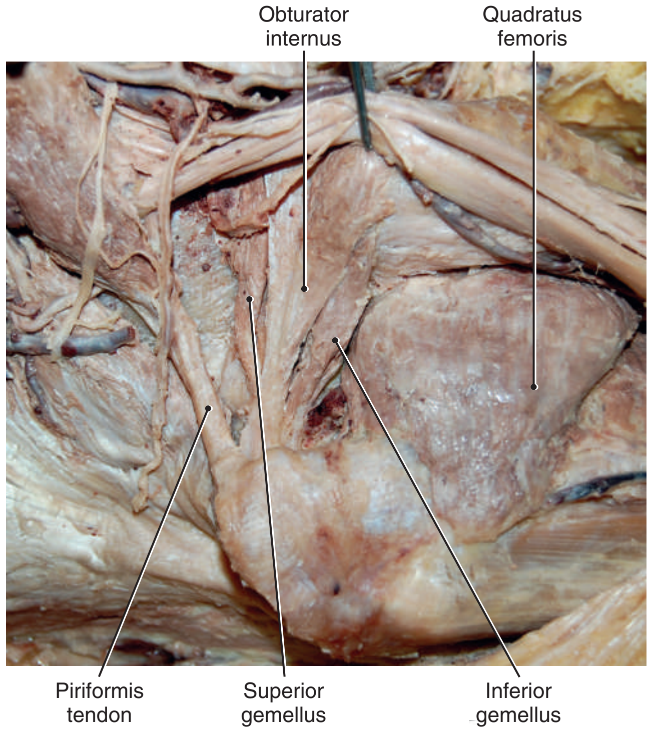
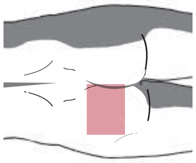

Obturator internus
Quadratus femoris
Piriformis tendon
Superior gemellus
Inferior gemellus

Fig. 16.19 Gluteal region close-up view highlighting lateral rotator muscles (piriformis, superior/inferior gemelli, obturator internus, quadratus femoris) with sciatic nerve reflected medially.



- Identify the borders of the gluteus medius and tensor fasciae latae muscles. The tensor fasciae latae muscle arises from the anterior portion of the iliac crest. Its tendon is covered by fascia lata and continues distally as the iliotibial tract. Place your fingertips at the inferior border of the gluteus medius muscle and lift it upward (Fig. 16.20).
- At the superior space between the gluteus maximus and gluteus medius muscles, identify the superficial branch of the superior gluteal artery (Figs. 16.21 and 16.22).
- Cut the attachment of the gluteus medius from the greater trochanter and reflect it superiorly. On its deep surface, identify the deep branch of the superior gluteal artery (see Fig. 16.22).
- The muscle exposed underneath the reflected gluteus medius is the gluteus minimus muscle. Deep and inferior to the sacrotuberous ligament, identify the nerve to the obturator internus, internal pudendal artery, its venae comitantes, and the pudendal nerve (Fig. 16.23). The venae comitantes are the pair of veins that accompany the internal pudendal artery.

DISSECTION TIP

The nerve to the quadratus femoris and inferior gemellus muscles is a small branch that may be found by retracting the sciatic nerve posteromedially; observe this small nerve traveling deep to the gemelli and obturator internus muscles.

PUDENDAL CANAL AND ISCHIOANAL FOSSA

Note: This part of the dissection involves opening the pudendal canal and dissecting the ischioanal fossa; it also may be performed separately with the dissection of the perineum.

- Dissect and clean away the adipose tissue of the structures inferior to the sacrotuberous ligament, and identify the internal pudendal artery, internal pudendal vein, and the pudendal nerve (Fig. 16.24).
- Identify the continuation of the obturator fascia at the ischioanal fossa, the *lunate fascia*. This fascia encircles the internal pudendal artery and vein and pudendal nerve branches (Figs. 16.25 and 16.26).

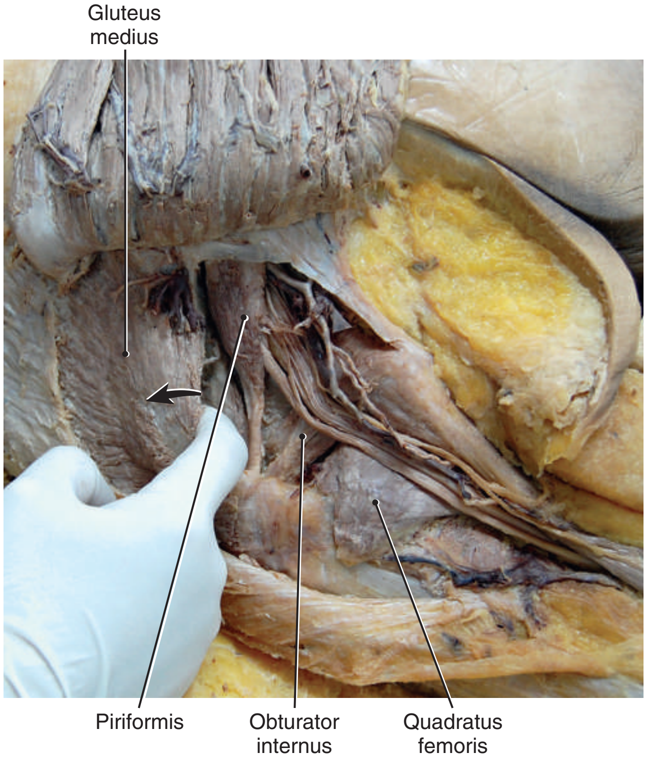
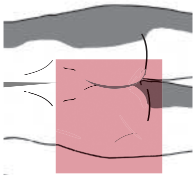


Fig. 16.20 Reflected gluteus maximus muscle reveals gluteus medius muscle, "lateral rotators" (piriformis, obturator internus, quadratus femoris muscles), and the sciatic nerve.



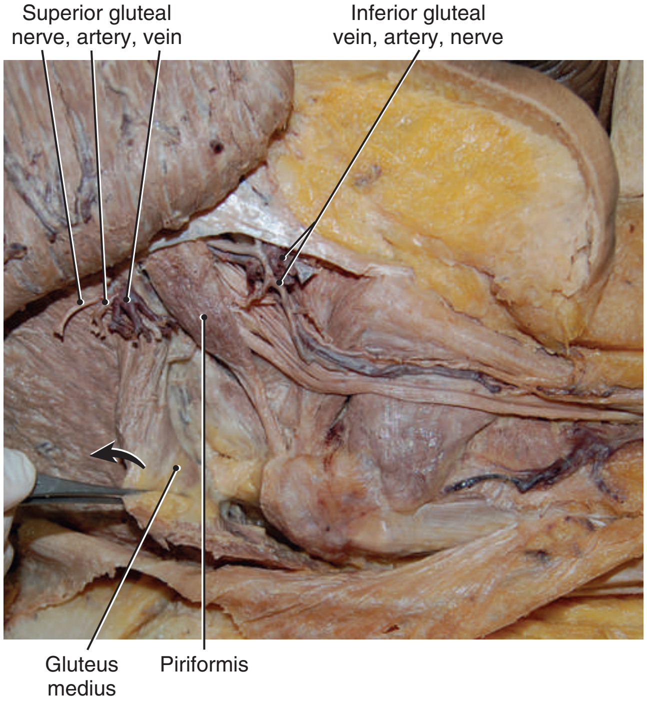
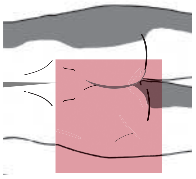

Superior gluteal nerve, artery, vein
Inferior gluteal vein, artery, nerve
Gluteus medius
Piriformis

Fig. 16.21 Gluteus maximus reflected, revealing piriformis muscle and superior and inferior gluteal neurovascular bundles.



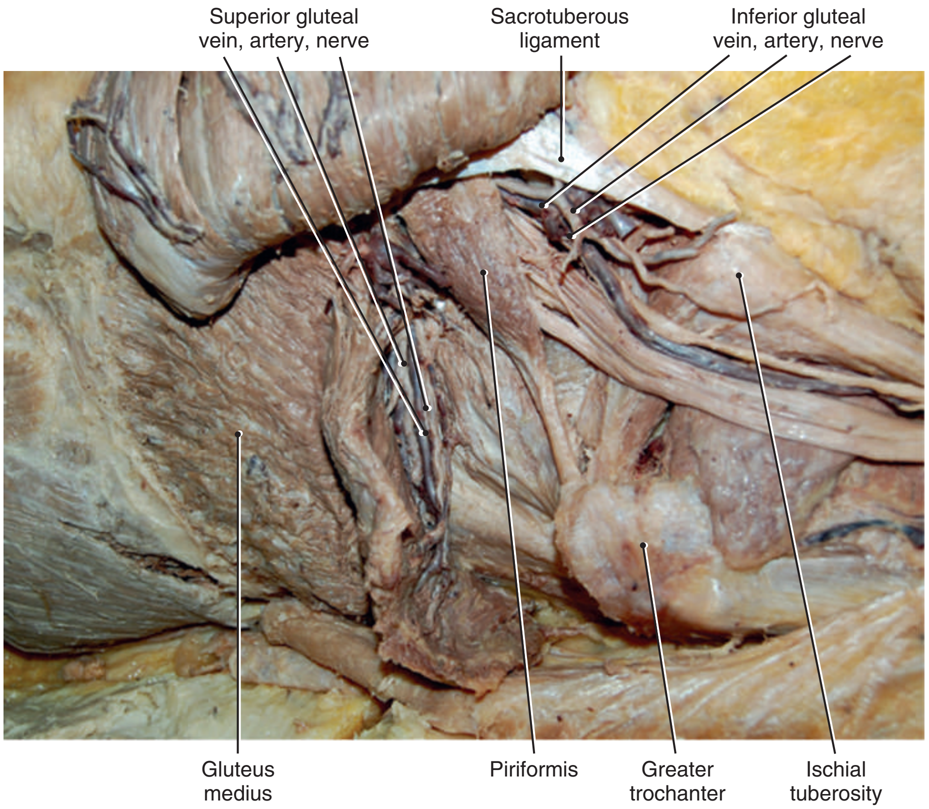
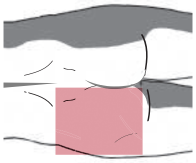

Superior gluteal vein, artery, nerve
Sacrotuberous ligament
Inferior gluteal vein, artery, nerve
Gluteus medius
Piriformis
Greater trochanter
Ischial tuberosity

Fig. 16.22 Gluteus maximus muscle reflected, highlighting piriformis muscle and superior and inferior gluteal neurovascular bundles.



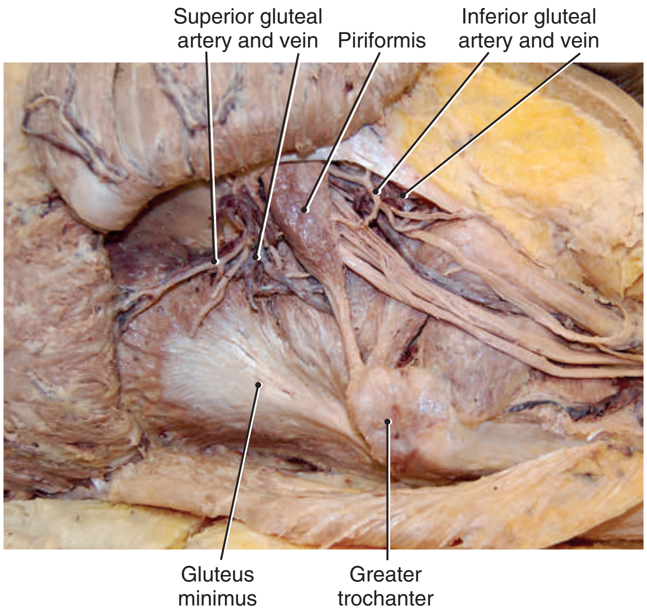
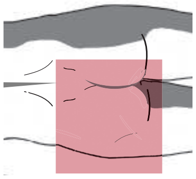

Superior gluteal artery and vein
Piriformis
Inferior gluteal artery and vein
Gluteus minimus
Greater trochanter

Fig. 16.23 Gluteal region with reflection of the gluteus maximus muscle medially and the gluteus medius muscle superiorly, revealing the gluteus minimus muscle and the superior gluteal neurovascular bundle lying superficial to the gluteus minimus muscle.



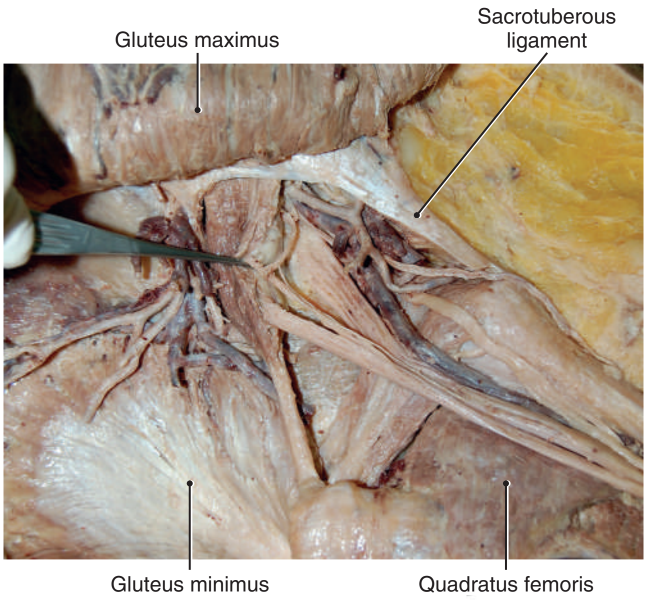
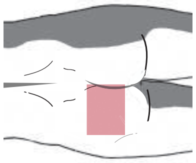
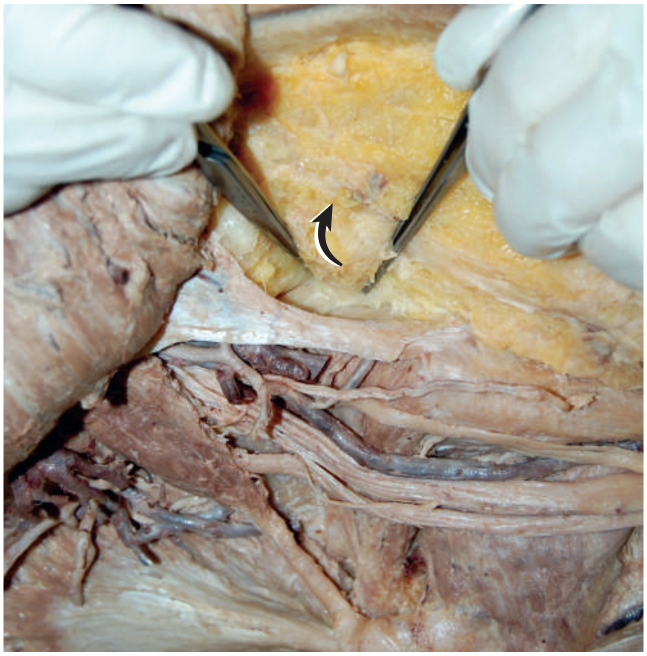

Gluteus maximus
Sacrotuberous ligament
Gluteus minimus
Quadratus femoris

Fig. 16.24 Gluteal region with reflection of the gluteus maximus muscle medially and gluteus medius muscle superiorly, revealing the gluteus minimus muscle and the superior gluteal neurovascular bundle lying superficial to the gluteus minimus muscle.





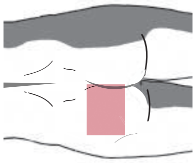
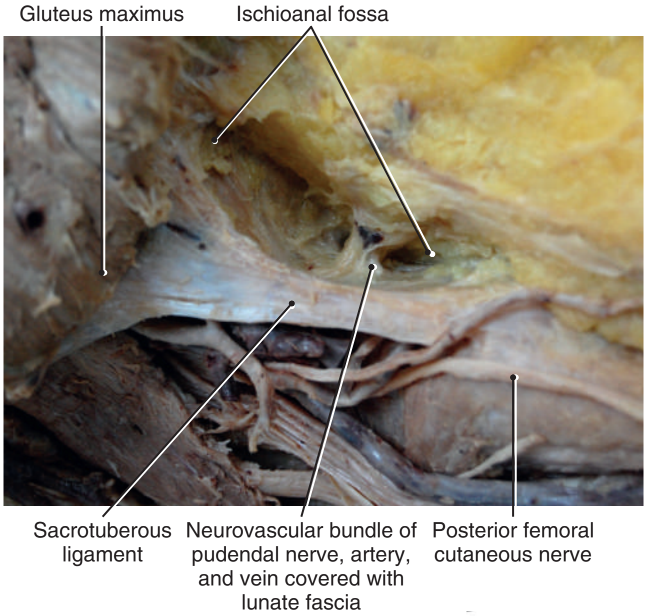


Fig. 16.25 Gluteal region with reflection of gluteus maximus, highlighting piriformis muscle, sacrotuberous ligament, and superior/inferior gluteal neurovascular bundles.


Gluteus maximus
Ischioanal fossa
Sacrotuberous ligament
Neurovascular bundle of pudendal nerve, artery, and vein covered with lunate fascia
Posterior femoral cutaneous nerve

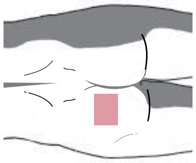
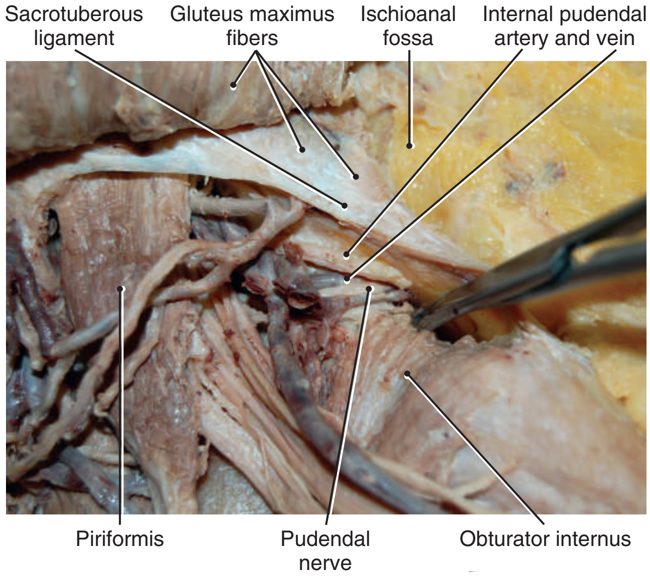


Fig. 16.26 Gluteus maximus reflected, revealing ischioanal fossa, sacrotuberous ligament, pudendal neurovascular bundle, and posterior femoral cutaneous nerve.

DISSECTION **TIP**

Identifying the lunate fascia and the point of entrance of the internal pudendal artery and vein and the pudendal nerve into the gluteal region is useful for exposing these structures when a large amount of adipose tissue is present.


Sacrotuberous ligament
Gluteus maximus fibers
Ischioanal fossa
Internal pudendal artery and vein
Piriformis
Pudendal nerve
Obturator internus

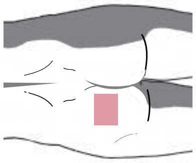


Fig. 16.27 Gluteus maximus muscle reflected, revealing sacrotuberous ligament, gluteus maximus fibers, ischioanal fossa border, obturator internus muscle, and pudendal neurovascular bundle.

- Separate the inferior border of the sacrotuberous ligament with scissors, and cut its inferior attachment from the ischial tuberosity (Fig. 16.27).
- Reflect the sacrotuberous ligament upward toward the reflected gluteus maximus muscle, and expose the contents of the pudendal canal (Alcock's canal) (Figs. 16.28 and 16.29).
- Expose the pudendal, inferior rectal, and perineal nerves (Fig. 16.30).
- Remove all the adipose tissue from the ischioanal fossa thoroughly so that the branches of the pudendal nerve and internal pudendal artery are fully identified (Figs. 16.31 and 16.32, Plate 16.1).
- Expose the levator ani muscle and the fascia of the obturator internus muscle as well as the external anal sphincter (Figs. 16.33 and 16.34, Plate 16.2).

POSTERIOR THIGH

- Palpate the iliotibial tract, the band into which the tensor fasciae latae and the gluteus maximus muscles (partially) insert.
- Note the lateral intermuscular septum, which begins from the deep surface of the fascia lata and attaches to the *linea aspera* (rough line) of the femur.
- Identify the space between the quadratus femoris and adductor magnus (adductor minimus) muscles, and find the medial femoral circumflex artery (Fig. 16.35).

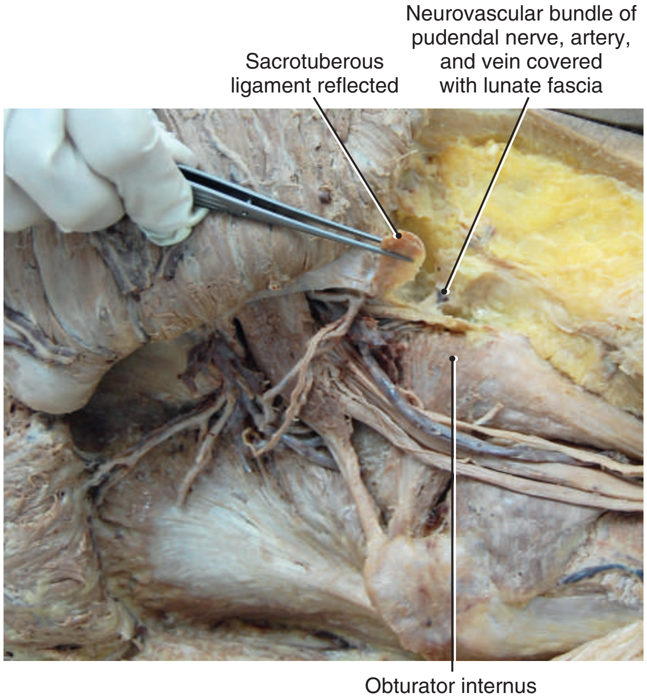
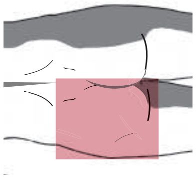

Neurovascular bundle of pudendal nerve, artery, and vein covered with lunate fascia
Sacrotuberous ligament reflected
Obturator internus

Fig. 16.28 Sacrotuberous ligament held between forceps with gluteus maximus muscle reflected, revealing ischioanal fossa border, obturator internus muscle, and pudendal neurovascular bundle within lunate fascia.



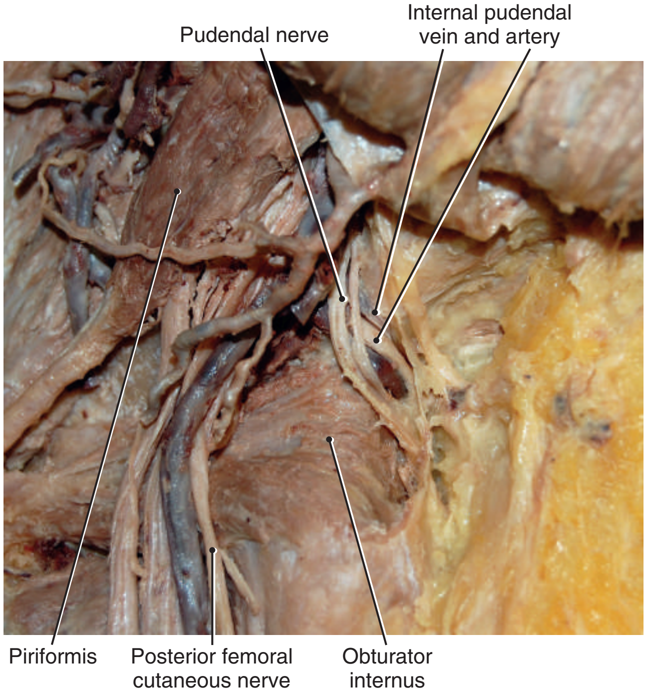
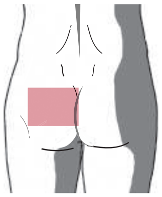

Internal pudendal vein and artery
Pudendal nerve
Piriformis
Posterior femoral cutaneous nerve
Obturator internus

Fig. 16.29 Gluteus maximus muscle reflected, revealing piriformis muscle, posterior femoral cutaneous nerve, obturator internus muscle, ischioanal fossa, pudendal nerve, and internal pudendal artery and vein.



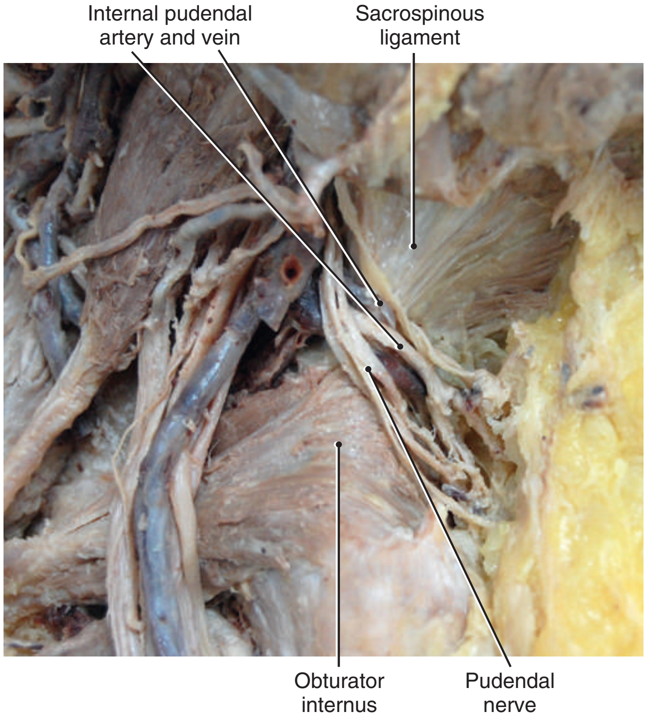
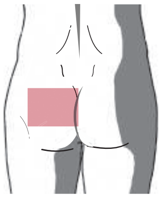

Internal pudendal artery and vein
Sacrospinous ligament
Obturator internus
Pudendal nerve

Fig. 16.30 Sacrotuberous ligament reflected, revealing obturator internus muscle, pudendal nerve, internal pudendal artery and vein, and sacrospinous ligament.



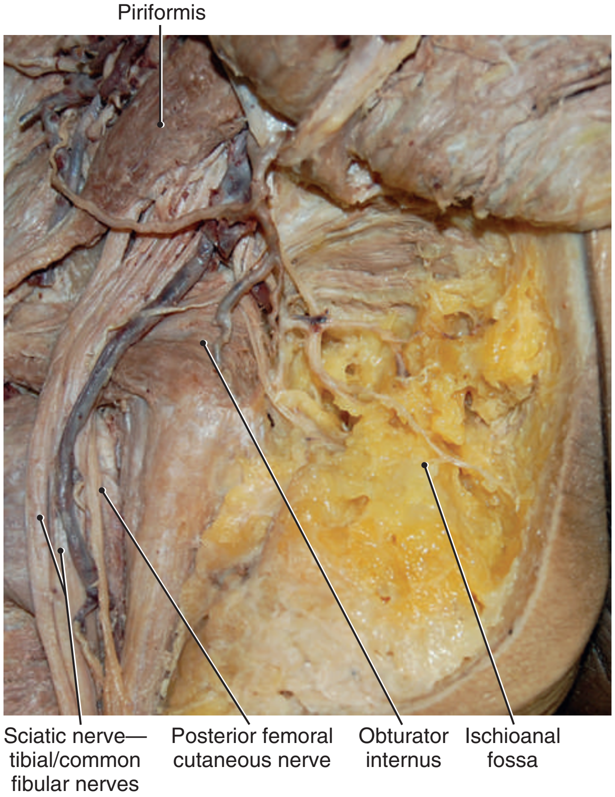
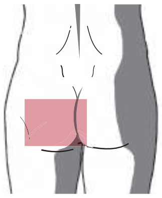

Piriformis
Sciatic nerve—tibial/common fibular nerves
Posterior femoral cutaneous nerve
Obturator internus
Ischioanal fossa

Fig. 16.31 Reflected gluteus maximus muscle reveals piriformis and obturator internus muscles, tibial and common fibular nerves of sciatic nerve, posterior femoral cutaneous nerve, and ischioanal fossa.



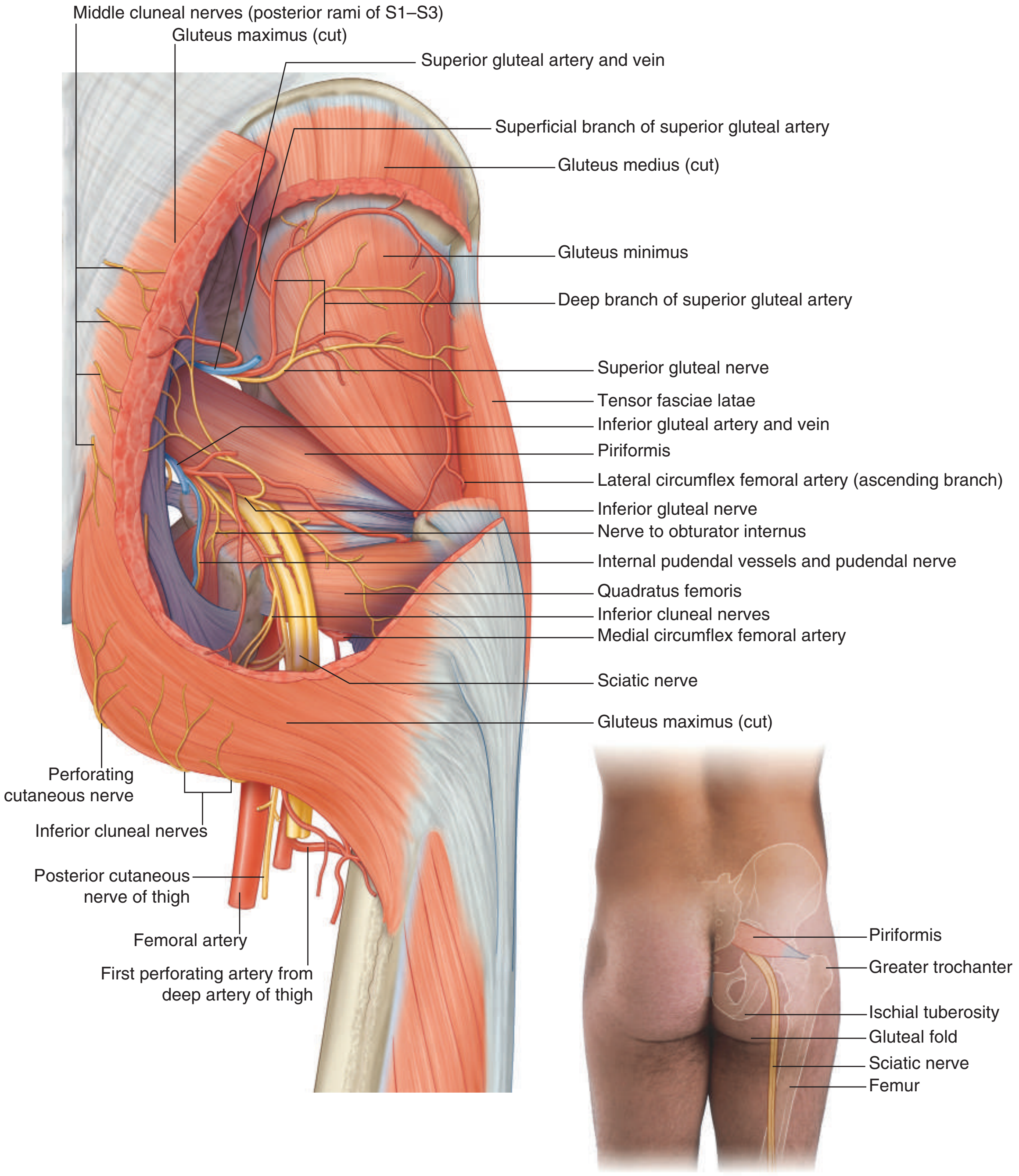

Middle cluneal nerves (posterior rami of S1–S3)
Gluteus maximus (cut)
Superior gluteal artery and vein
Superficial branch of superior gluteal artery
Gluteus medius (cut)
Gluteus minimus
Deep branch of superior gluteal artery
Superior gluteal nerve
Tensor fasciae latae
Inferior gluteal artery and vein
Piriformis
Lateral circumflex femoral artery (ascending branch)
Inferior gluteal nerve
Nerve to obturator internus
Internal pudendal vessels and pudendal nerve
Quadratus femoris
Inferior cluneal nerves
Medial circumflex femoral artery
Sciatic nerve
Gluteus maximus (cut)
Perforating cutaneous nerve
Inferior cluneal nerves
Posterior cutaneous nerve of thigh
Femoral artery
First perforating artery from deep artery of thigh
Piriformis
Greater trochanter
Ischial tuberosity
Gluteal fold
Sciatic nerve
Femur

Plate 16.1 Arteries and nerves of the gluteal region and sciatic nerve in the gluteal region as it relates to the surface (posterior view).

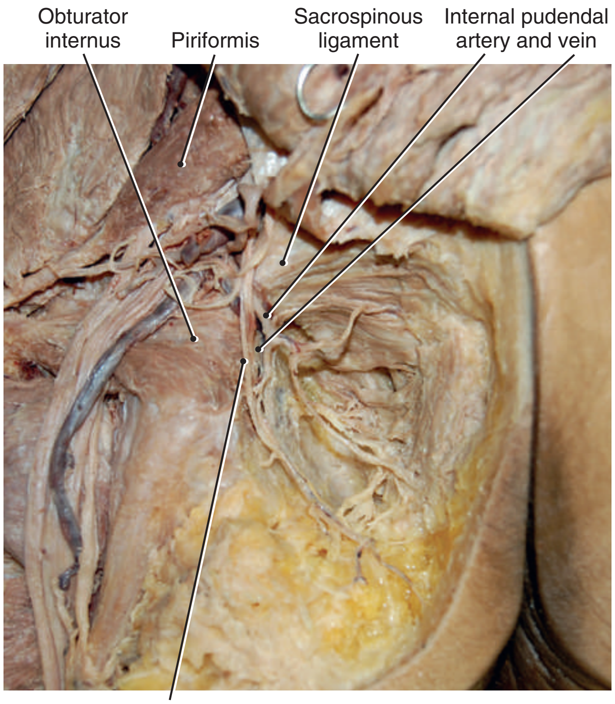
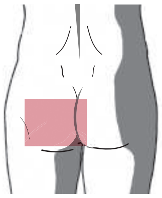

Obturator internus
Piriformis
Sacrospinous ligament
Internal pudendal artery and vein
Pudendal nerve

Fig. 16.32 Sacrotuberous ligament reflected, revealing obturator internus, pudendal nerve, internal pudendal artery and vein, and sacrospinous ligament.



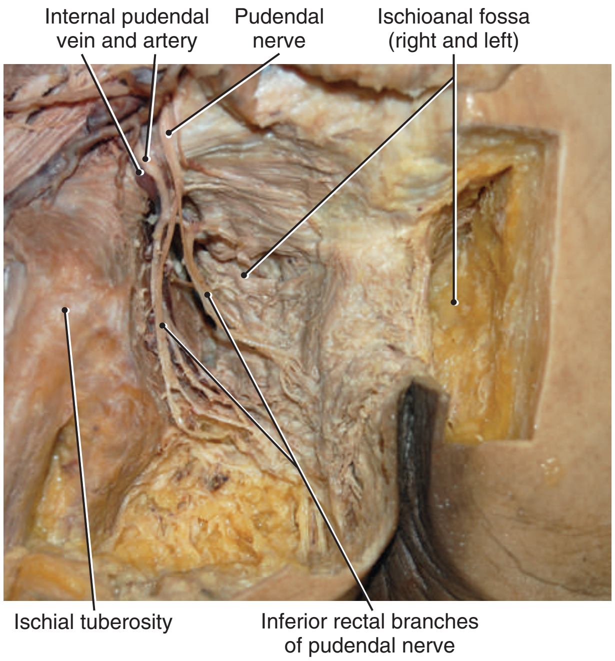
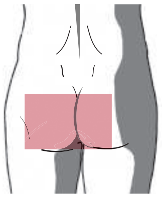

Internal pudendal vein and artery
Pudendal nerve
Ischioanal fossa (right and left)
Ischial tuberosity
Inferior rectal branches of pudendal nerve

Fig. 16.34 Bilateral ischioanal fossae highlighting subcutaneous fat, pudendal nerve, internal pudendal artery and vein, and inferior rectal nerve branches.



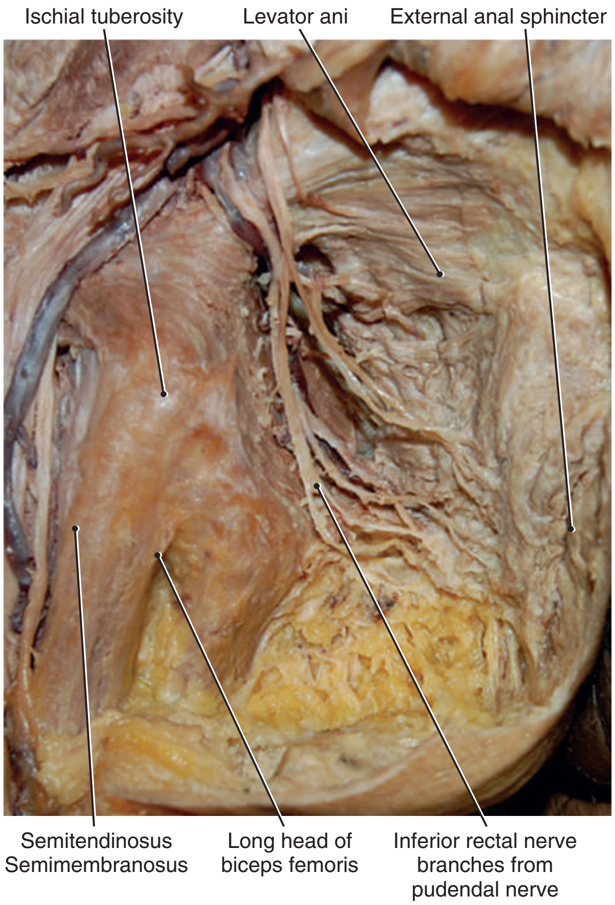
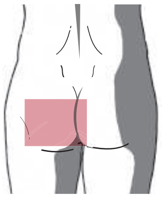

Ischial tuberosity
Levator ani
External anal sphincter
Semitendinosus Semimembranosus
Long head of biceps femoris
Inferior rectal nerve branches from pudendal nerve

Fig. 16.33 Superior aspect of posterior thigh and ischioanal fossa, highlighting ischial tuberosity, "hamstring" muscles (semitendinosus, semimembranosus, long head of biceps femoris), and inferior rectal nerve branches.



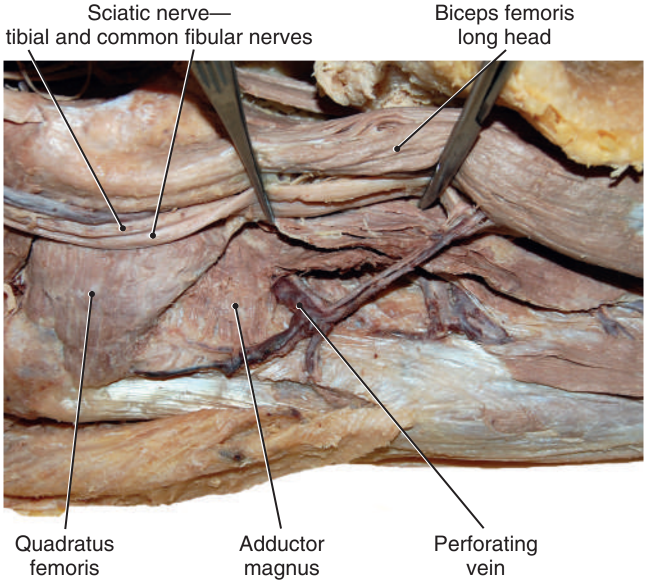
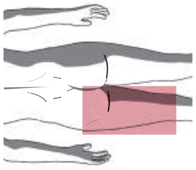

Sciatic nerve—tibial and common fibular nerves
Biceps femoris long head
Quadratus femoris
Adductor magnus
Perforating vein

Fig. 16.35 Superior posterior thigh with retracted tibial and common fibular nerves and long head of biceps femoris muscle, highlighting quadratus femoris and adductor longus muscles and perforating vein.



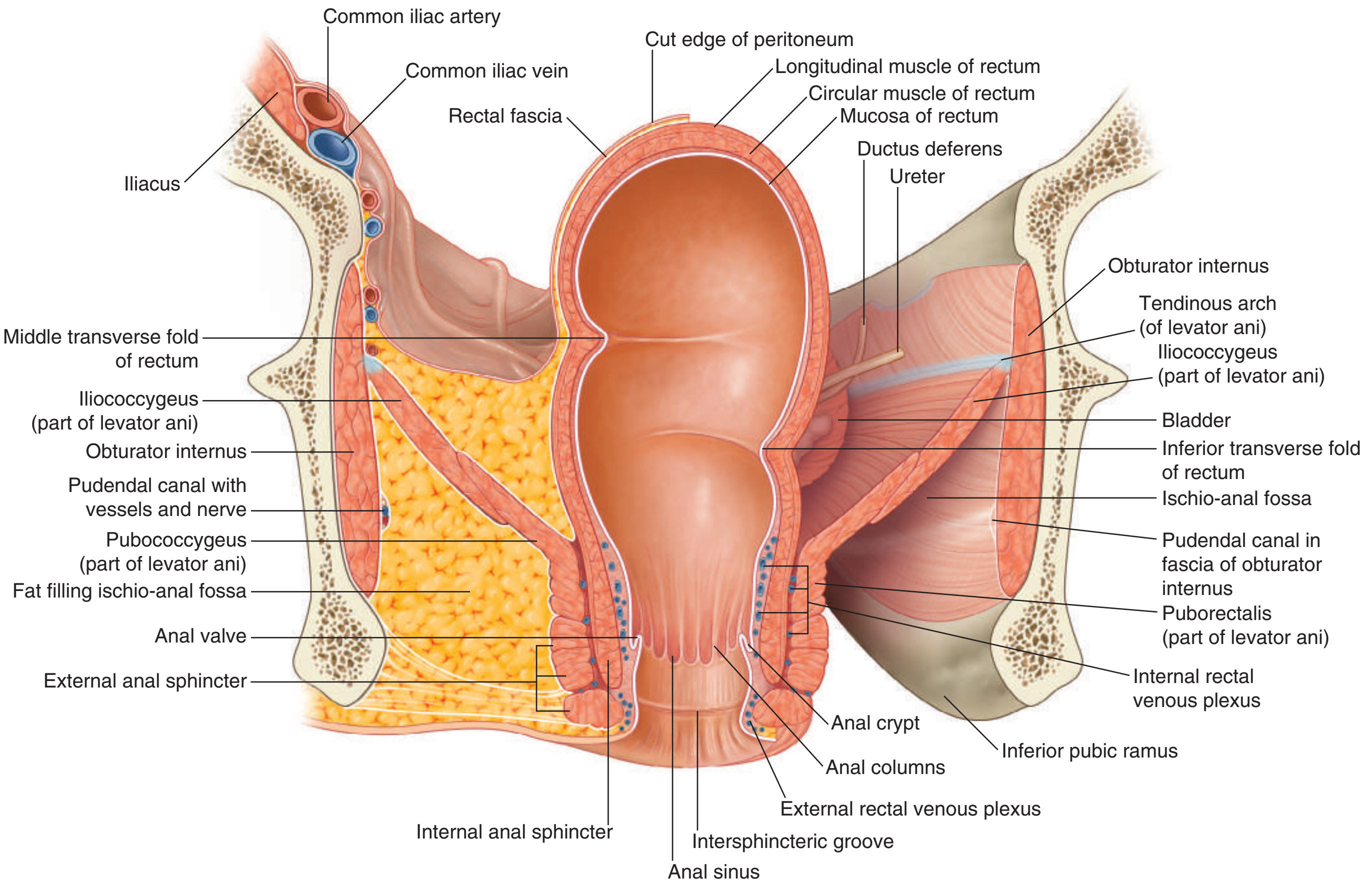

Common iliac artery
Common iliac vein
Iliacus
Rectal fascia
Cut edge of peritoneum
Longitudinal muscle of rectum
Circular muscle of rectum
Mucosa of rectum
Ductus deferens
Ureter
Obturator internus
Tendinous arch
(of levator ani)
Iliococcygeus
(part of levator ani)
Middle transverse fold
of rectum
Iliococcygeus
(part of levator ani)
Obturator internus
Pudendal canal with
vessels and nerve
Pubococcygeus
(part of levator ani)
Fat filling ischio-anal fossa
Anal valve
External anal sphincter
Bladder
Inferior transverse fold
of rectum
Ischio-anal fossa
Pudendal canal in
fascia of obturator
internus
Puborectalis
(part of levator ani)
Internal rectal
venous plexus
Anal crypt
Inferior pubic ramus
Anal columns
External rectal venous plexus
Internal anal sphincter
Intersphincteric groove
Anal sinus

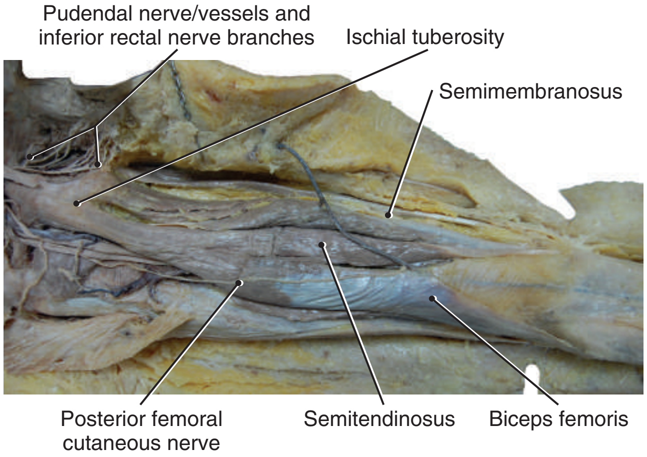
Plate 16.2 Coronal section through rectum and anal canal depicting the contents of ischioanal fossa.

- With blunt dissection, separate the muscles of the posterior thigh ("hamstrings"), and identify the long and short heads of the biceps femoris muscle as well as the semitendinosus and semimembranous muscles (Fig. 16.36).
- Dissect out their origins from the ischial tuberosity.
- Retract the long head of the biceps femoris laterally to expose the sciatic nerve.
- Note the division of the sciatic nerve into the tibial and common fibular (peroneal) nerves as it approaches the popliteal fossa (Fig. 16.37).

DISSECTION **TIP**

Typically, the division of the sciatic nerve into the tibial and common fibular nerves occurs near the popliteal fossa. However, some cadavers may have a high split of the sciatic nerve, or two nerves may exit from the inferior border of the piriformis muscle, with a lateral nerve (common fibular) and a medial nerve (tibial).

- Look at the lateral aspect of the sciatic nerve. The only branches to arise from its lateral surface innervate the short head of the biceps femoris muscle (Fig. 16.38).
- Clean the perforating arteries and veins, which provide the arterial supply and venous drainage of the posterior thigh (Figs. 16.39 to 16.41, Plate 16.3).


Pudendal nerve/vessels and
inferior rectal nerve branches
Ischial tuberosity
Semimembranosus
Posterior femoral
cutaneous nerve
Semitendinosus
Biceps femoris

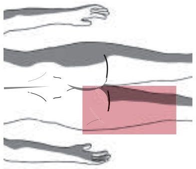


Fig. 16.36 Reflected skin and subcutaneous tissue of posterior thigh and ischioanal fossa, revealing pudendal nerve superiorly and inferior rectal nerve inferiorly, internal pudendal artery and vein, ischial tuberosity, and biceps femoris, semitendinosus, and semimembranosus muscles.

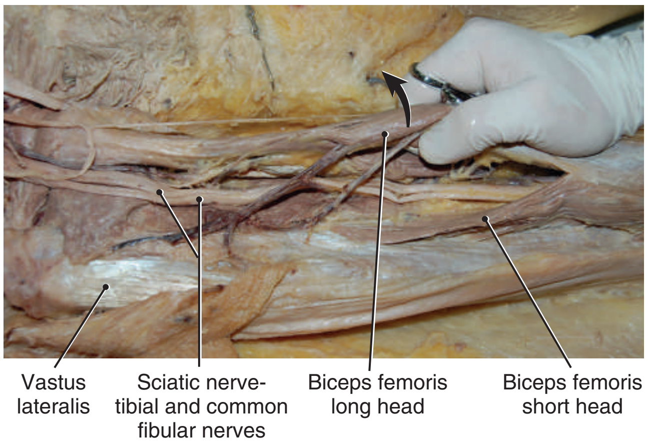
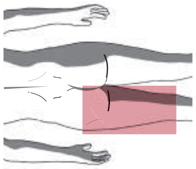

Vastus lateralis
Sciatic nerve-tibial and common fibular nerves
Biceps femoris long head
Biceps femoris short head

Fig. 16.37 Posterior thigh, highlighting sciatic nerve (tibial/common fibular nerves) and biceps femoris muscle (long and short heads).



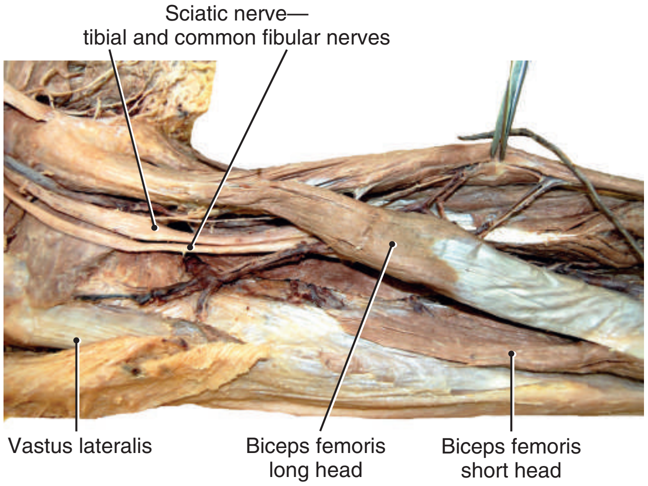
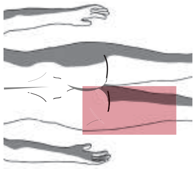

Sciatic nerve—tibial and common fibular nerves
Vastus lateralis
Biceps femoris long head
Biceps femoris short head

Fig. 16.38 Posterior thigh, showing tibial and common fibular nerves of sciatic nerve long and short heads of biceps femoris muscle.



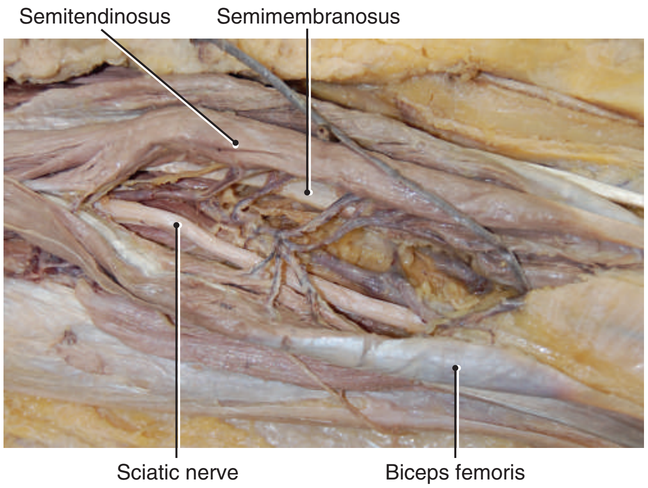
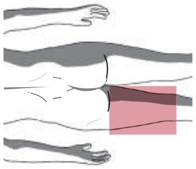

Semitendinosus
Semimembranosus
Sciatic nerve
Biceps femoris

Fig. 16.39 Posterior thigh, highlighting sciatic nerve between "hamstrings": biceps femoris lateral, semitendinosus medial and superficial, and semimembranosus muscle medial and deep.



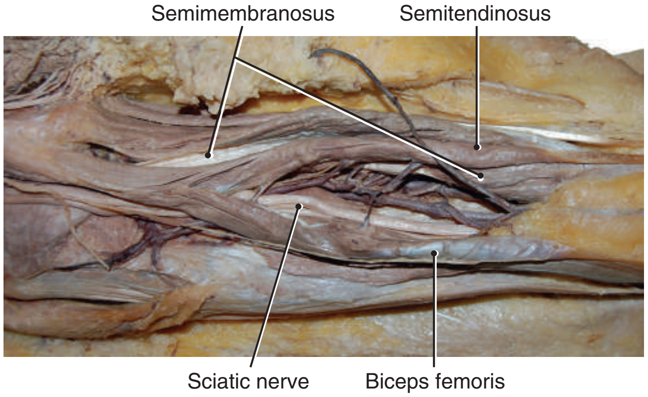
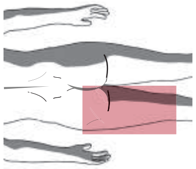
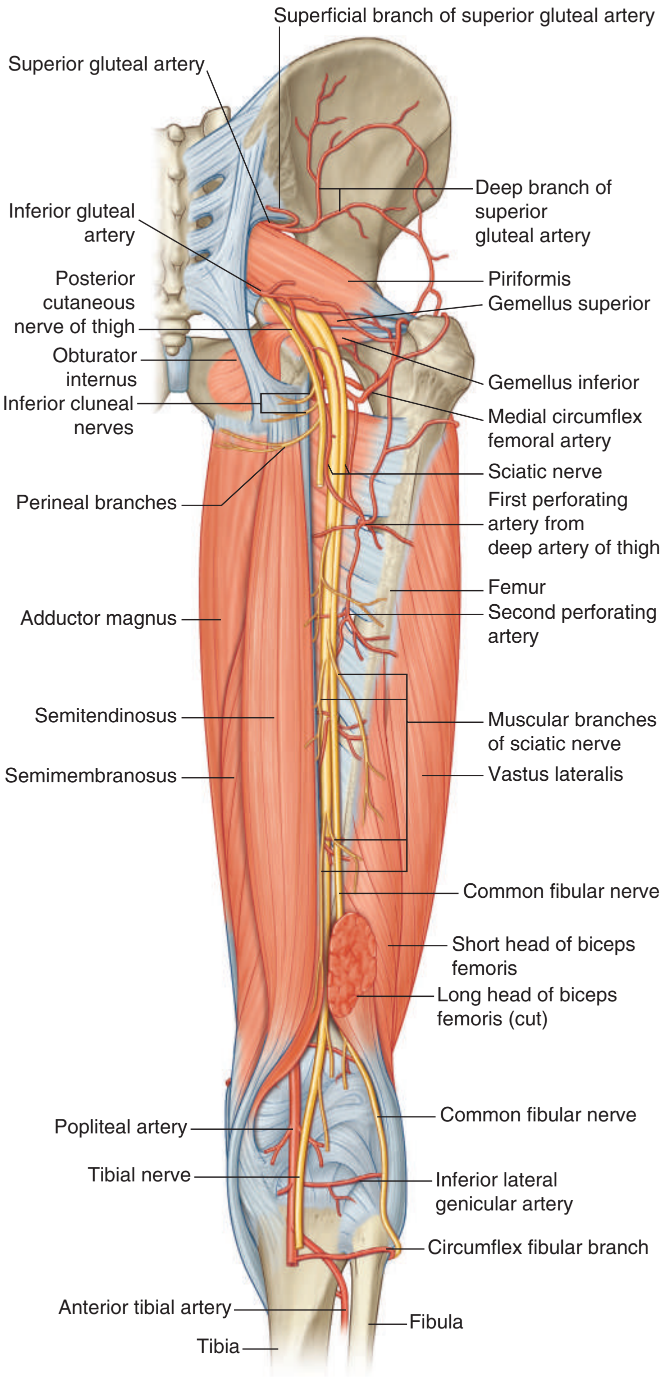

Semimembranosus
Semitendinosus
Sciatic nerve
Biceps femoris

Fig. 16.40 Posterior thigh, showing sciatic nerve between hamstring muscles (biceps femoris, semitendinosus, semimembranosus).




Superficial branch of superior gluteal artery
Superior gluteal artery
Inferior gluteal artery
Deep branch of superior gluteal artery
Posterior cutaneous nerve of thigh
Piriformis
Gemellus superior
Obturator internus
Inferior cluneal nerves
Gemellus inferior
Medial circumflex femoral artery
Sciatic nerve
Perineal branches
First perforating artery from deep artery of thigh
Femur
Adductor magnus
Second perforating artery
Semitendinosus
Muscular branches of sciatic nerve
Semimembranosus
Vastus lateralis
Common fibular nerve
Short head of biceps femoris
Long head of biceps femoris (cut)
Popliteal artery
Common fibular nerve
Tibial nerve
Inferior lateral genicular artery
Circumflex fibular branch
Anterior tibial artery
Fibula
Tibia

Arteries and nerves of the thigh (posterior view)

Plate 16.3 Arteries and nerves of the posterior thigh.

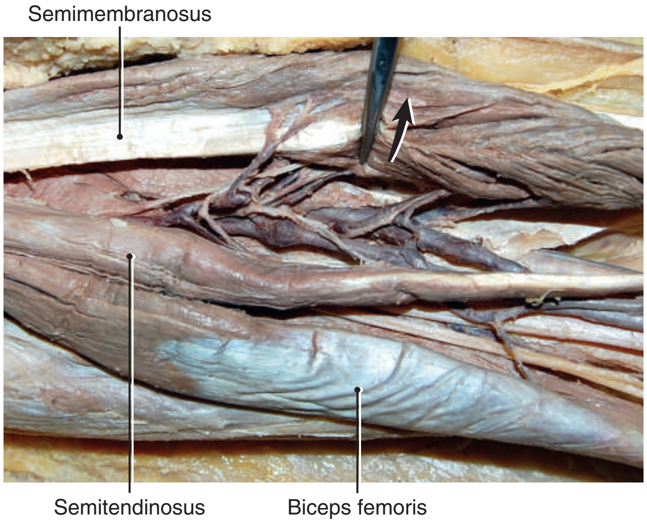
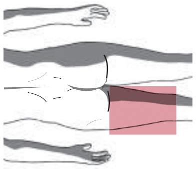

Semimembranosus
Semitendinosus
Biceps femoris

Fig. 16.41 Posterior thigh revealing musculature: biceps femoris laterally, semitendinosus reflected laterally, and semimembranosus medially.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Superior gluteal
- ☐ Inferior gluteal
- ☐ Pudendal
  - ☐ Inferior rectal
- ☐ Posterior femoral cutaneous
  - ☐ Sciatic
    - ☐ Tibial (medial)
    - ☐ Common fibular (lateral)

ARTERIES

- ☐ Superior gluteal
- ☐ Inferior gluteal
- ☐ Internal pudendal
  - ☐ Inferior rectal
- ☐ Medial femoral circumflex
- ☐ Perforating arteries

VEINS

- ☐ Superior gluteal
- ☐ Inferior gluteal
- ☐ Internal pudendal
- ☐ Perforating veins

MUSCLES

- ☐ Gluteus maximus
- ☐ Gluteus medius
- ☐ Gluteus minimus
- ☐ Piriformis
- ☐ Superior gemellus
- ☐ Obturator internus
- ☐ Inferior gemellus
- ☐ Quadratus femoris
- ☐ Semimembranosus
- ☐ Semitendinosus
- ☐ Biceps femoris
  - ☐ Long head
  - ☐ Short head
- ☐ Adductor minimus
- ☐ Tensor fasciae latae
- ☐ Levator ani
- ☐ External anal sphincter

LIGAMENTS

- ☐ Sacrotuberous
- ☐ Sacrospinous

FOSSA/CANAL

- ☐ Ischioanal fossa
- ☐ Alcock's canal

FASCIA

- ☐ Gluteal
- ☐ Obturator internus
- ☐ Lunate
- ☐ Fascia lata
- ☐ Iliotibial tract

BURSA

- ☐ Trochanteric bursa

CHAPTER 17 THIGH AND LEG

ATLAS REFERENCES

Netter: 480–485, 490–491
McMinn: 320–327
Gray's Atlas: 299, 300, 306–317

BEFORE YOU BEGIN

Palpate the following bony landmarks on the cadaver or on yourself:

- Anterior superior iliac spine
- Pubic tubercle
- Pubic symphysis
- Greater trochanter of femur
- Medial and lateral femoral condyles
- Patella
- Tibial tuberosity
- Head and neck of fibula
- Medial and lateral malleoli of tibia and fibula, respectively

DISSECTION STEPS

- ○ **Make a horizontal skin incision on the thigh 2 to 3 cm (~1 inch) inferior and parallel to the inguinal ligament.**
- ○ **Leave the skin intact over the external genitalia.**
- ○ **At the midpoint of this horizontal incision, make a vertical incision to the anterior portion of the patella.**
- ○ **Make an encircling incision around the knee (Fig. 17.1).**
- ○ **Reflect the skin medially over the thigh, and identify the superficial veins (Fig. 17.2).**
- ○ **Continue the dissection by making a vertical incision from the knee toward the ankle (Fig. 17.3).**
- ○ **Make a transverse incision between the malleoli.**
- ○ **Reflect the skin of the leg laterally (Fig. 17.4).**
- ○ **Start exposing the superficial veins of the leg and thigh (Fig. 17.5).**
- ○ **Identify the great saphenous vein and saphenous nerve (Fig. 17.6).**
- ○ **Clean the superficial fascia over the *great saphenous vein,* starting from the ankle toward the knee (Fig. 17.7).**

ANATOMY **NOTE**

Around the knee, the saphenous nerve is located deep to the great saphenous vein. In the leg medial to the tibia, however, the great saphenous vein runs parallel with the saphenous nerve (Fig. 17.8). The great saphenous vein arises from the medial side of the dorsal venous arch of the foot and ascends anterior to the medial malleolus, along the medial side of the leg and thigh, finally draining into the femoral vein.

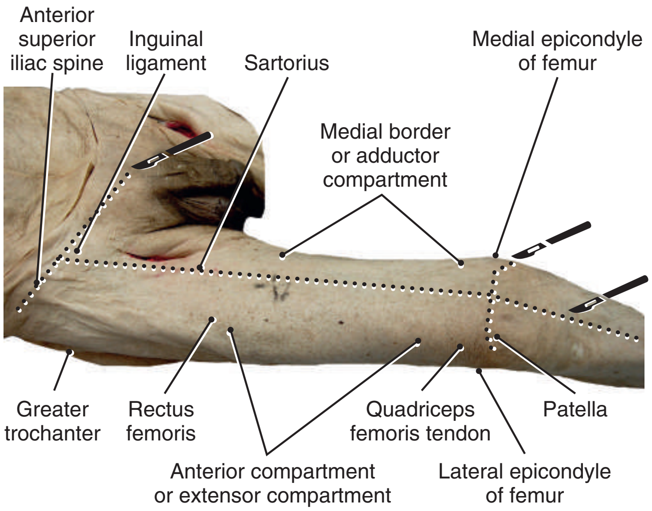

Anterior superior iliac spine
Inguinal ligament
Sartorius
Medial epicondyle of femur
Medial border or adductor compartment
Greater trochanter
Rectus femoris
Quadriceps femoris tendon
Patella
Anterior compartment or extensor compartment
Lateral epicondyle of femur

Fig. 17.1 Three thigh dissection incisions: horizontal cut inferior and parallel to inguinal ligament, vertical cut to anterior patella at midpoint of horizontal incision, and encircling cut around the knee.

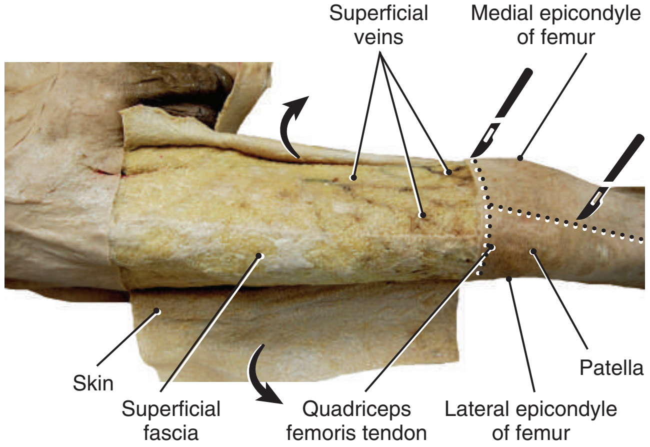

Superficial veins
Medial epicondyle of femur
Patella
Skin
Superficial fascia
Quadriceps femoris tendon
Lateral epicondyle of femur

Fig. 17.2 Skin reflected medially over thigh, revealing superficial veins.

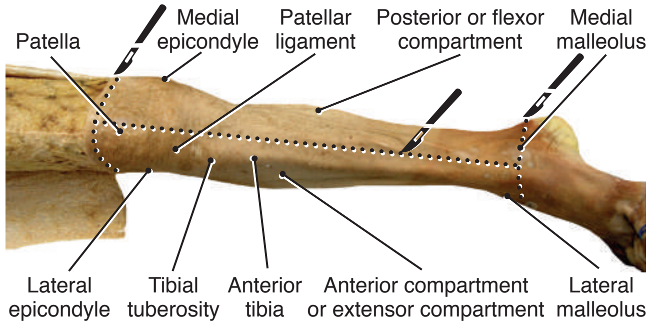

Patella
Medial epicondyle
Patellar ligament
Posterior or flexor compartment
Medial malleolus
Lateral epicondyle
Tibial tuberosity
Anterior tibia
Anterior compartment or extensor compartment
Lateral malleolus

Fig. 17.3 Vertical incision from the knee toward the ankle and transverse incision between the malleoli.

- Identify the great saphenous nerve and note its relationship to the saphenous vein medial to the tibia.
- Remove the skin from the posterior aspect of the leg to the ankle (Fig. 17.9).
- Leave the superficial and deep fasciae (crural fascia) intact.
- Identify the *small* (lesser) *saphenous vein*, which begins from the lateral aspect of the dorsal venous arch of the foot.

ANATOMY **NOTE**

The small saphenous vein ascends just inferior to the lateral malleolus, accompanying the sural nerve, and finally drains into the popliteal vein (Fig. 17.10).

- Identify the sural nerve.
- Observe the sural nerve and the small saphenous vein as they penetrate the deep crural fascia to travel to the popliteal fossa (Fig. 17.11).
- On the anterior part of the leg, on its medial side over the patellar ligament, expose the infrapatellar branch of the saphenous nerve (Fig. 17.12).
- Follow the great saphenous vein toward the thigh, and clean the fat off the superficial fascia around the vein (Fig. 17.13).

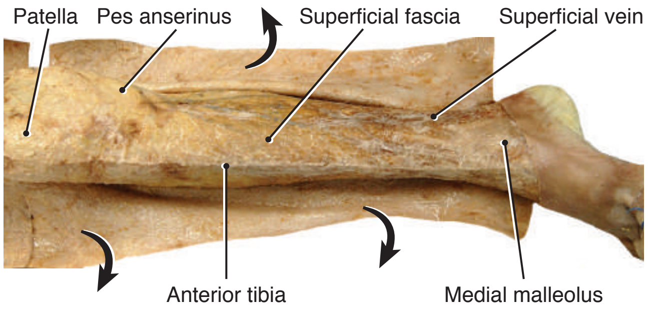
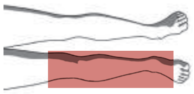

Patella
Pes anserinus
Superficial fascia
Superficial vein
Anterior tibia
Medial malleolus

Fig. 17.4 Transverse cut between the malleoli, with skin of leg reflected laterally.



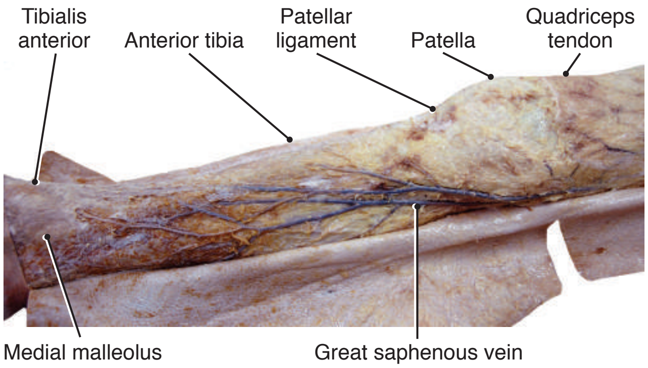
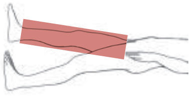

Tibialis anterior
Anterior tibia
Patellar ligament
Patella
Quadriceps tendon
Medial malleolus
Great saphenous vein

Fig. 17.6 Skin of leg reflected, showing great saphenous vein and tibialis anterior muscle.



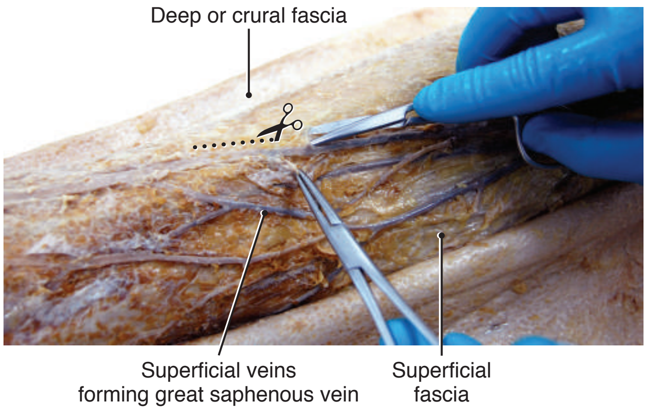
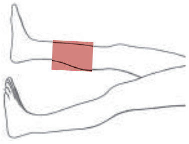

Deep or crural fascia
Superficial veins forming great saphenous vein
Superficial fascia

Fig. 17.7 Superficial fascia cleaned away over great saphenous vein.



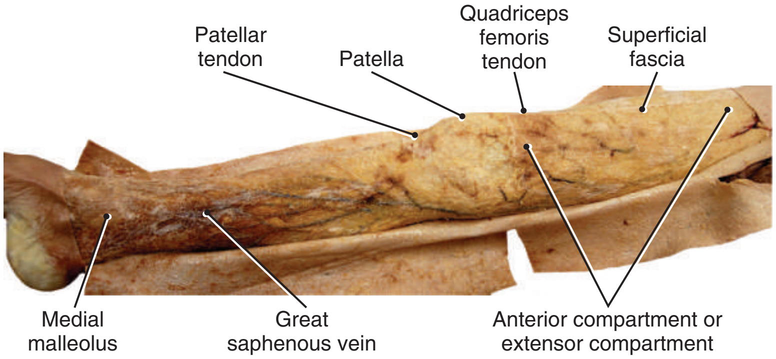
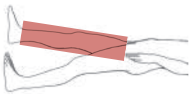

Patellar tendon
Patella
Quadriceps femoris tendon
Superficial fascia
Medial malleolus
Great saphenous vein
Anterior compartment or extensor compartment

Fig. 17.5 Exposure of superficial veins of the leg and thigh.



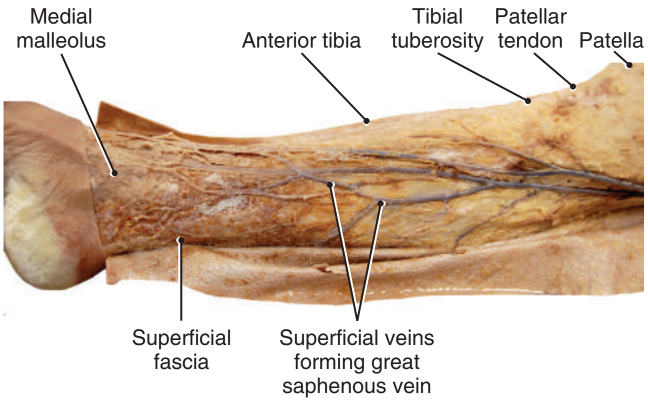
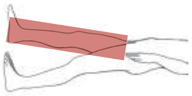

Medial malleolus
Anterior tibia
Tibial tuberosity
Patellar tendon
Patella
Superficial fascia
Superficial veins forming great saphenous vein

Fig. 17.8 In the leg medial to the tibia, note how the great saphenous vein runs parallel with the saphenous nerve.



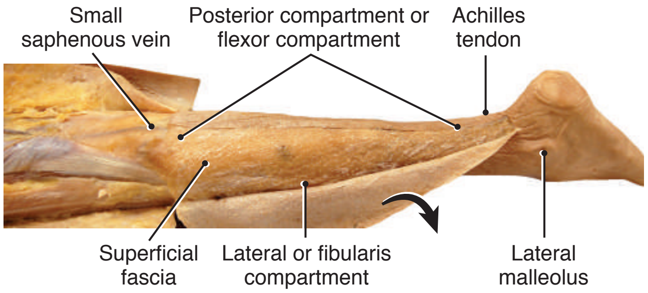
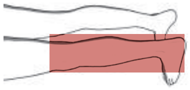

Small saphenous vein
Posterior compartment or flexor compartment
Achilles tendon
Superficial fascia
Lateral or fibularis compartment
Lateral malleolus

Fig. 17.9 Skin of leg reflected to the ankle.



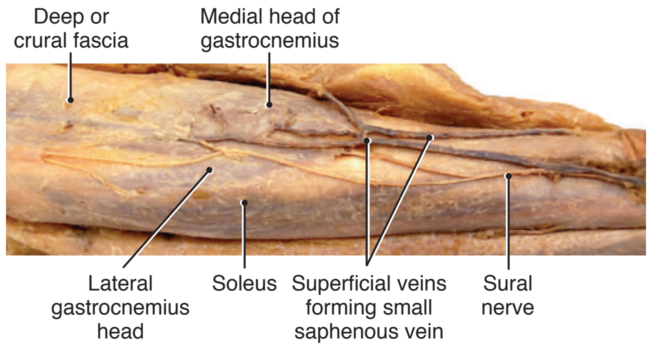
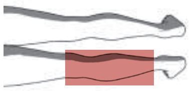

Deep or crural fascia
Medial head of gastrocnemius
Lateral gastrocnemius head
Soleus
Superficial veins forming small saphenous vein
Sural nerve

Fig. 17.11 Reflected view shows sural nerve and small saphenous vein penetrating deep (crural) fascia to travel to popliteal fossa.



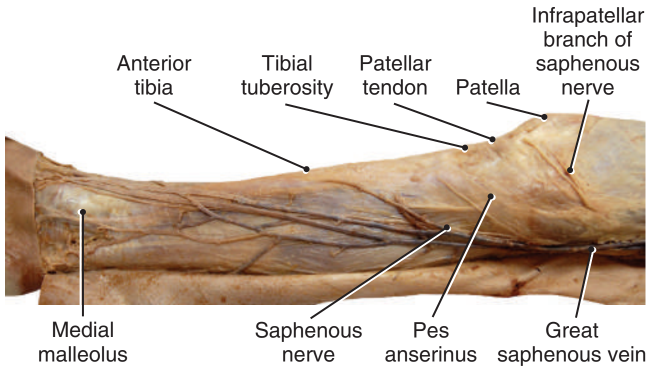
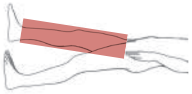

Anterior tibia
Tibial tuberosity
Patellar tendon
Patella
Infrapatellar branch of saphenous nerve
Medial malleolus
Saphenous nerve
Pes anserinus
Great saphenous vein

Fig. 17.12 Infrapatellar branch of saphenous nerve exposed on medial side of anterior leg over patellar ligament.



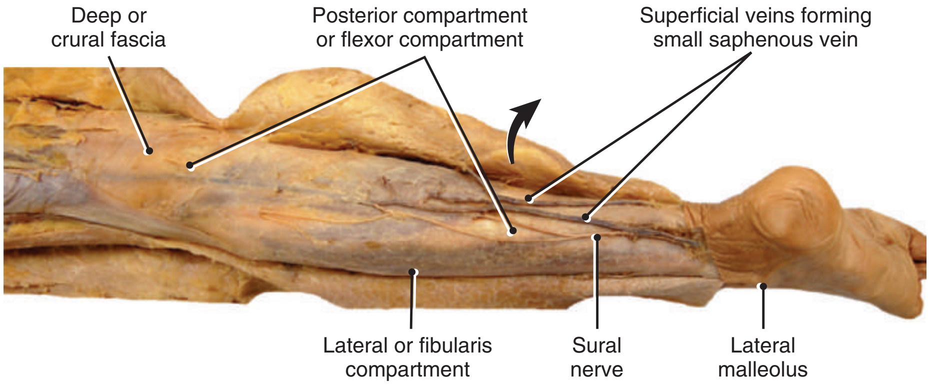
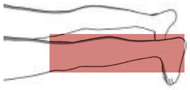
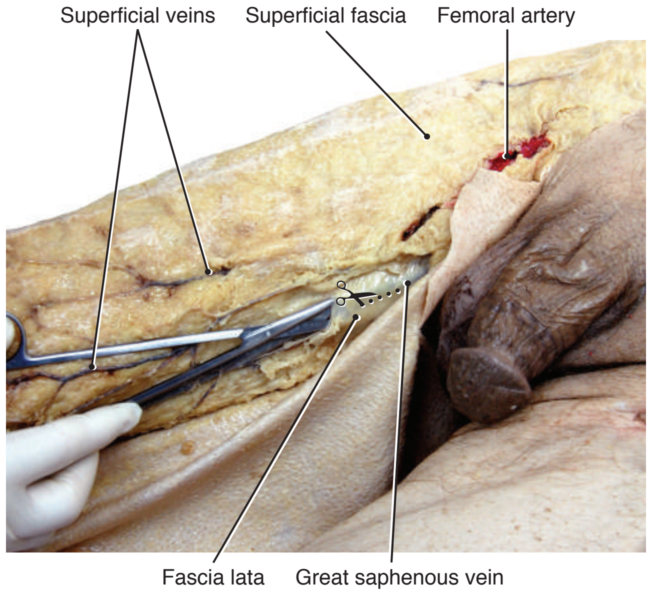

Deep or crural fascia
Posterior compartment or flexor compartment
Superficial veins forming small saphenous vein
Lateral or fibularis compartment
Sural nerve
Lateral malleolus

Fig. 17.10 Skin of leg reflected, revealing posterior and lateral compartments, deep fascia, and small saphenous vein.



- Expose the great saphenous vein toward the *fossa ovalis* (saphenous hiatus), the opening in the deep fascia, where the vein travels through to drain into the femoral vein.
- Expose the superficial and deep perforating tributaries of the great saphenous vein (Fig. 17.14).
- Start cleaning fat from around the great saphenous vein, extending the dissection medially and laterally (Fig. 17.15).
- Do not cut through the deep fascia of the thigh, but identify the anterior cutaneous branches of the femoral nerve intermingled with the tributaries of the great saphenous vein.
- Lateral to the vein, identify the rectus femoris muscle.
- On top of and lateral to the muscle, identify the lateral femoral cutaneous nerves (Fig. 17.16).


Superficial veins
Superficial fascia
Femoral artery
Fascia lata
Great saphenous vein

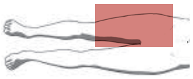
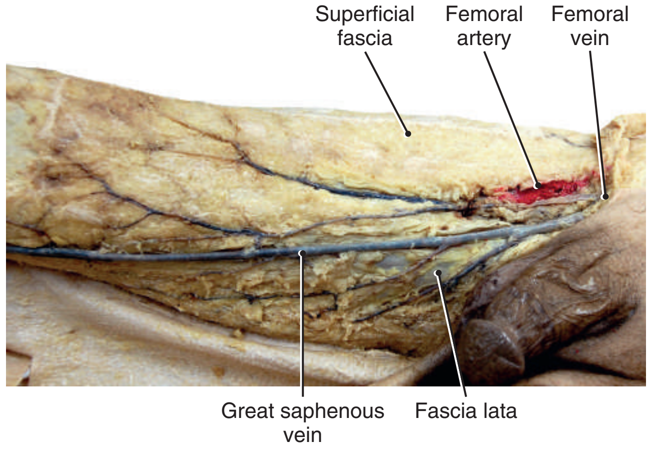


Fig. 17.13 Fat of superficial fascia cleaned away around great saphenous vein.


Superficial fascia
Femoral artery
Femoral vein
Great saphenous vein
Fascia lata

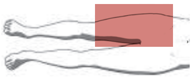
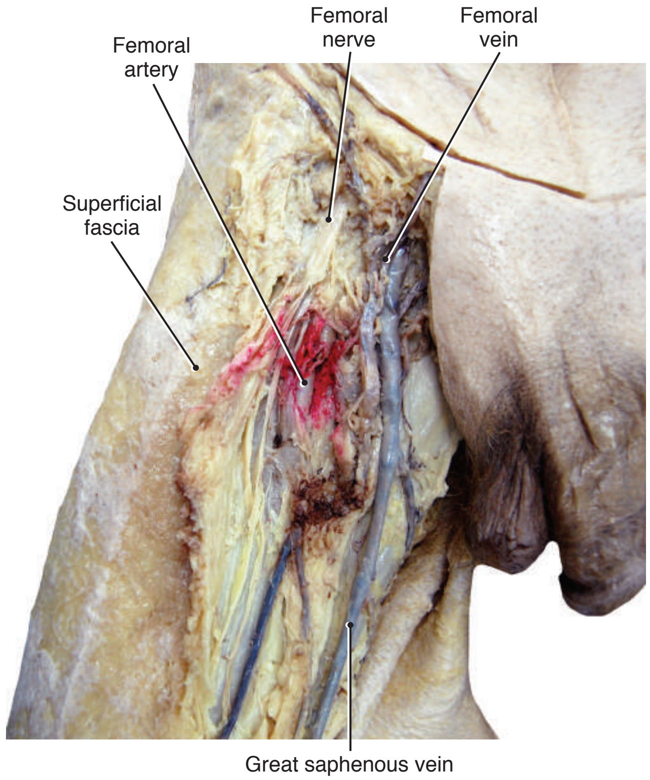


Fig. 17.14 View of great saphenous vein and its superficial and deep perforating tributaries.

DISSECTION TIP

Observe the lymphatics in the area of the fossa ovalis, but do not spend time exposing all of them. Realize that the inguinal lymph nodes are so named based on their position relative to the deep fascia. The deep inguinal lymph nodes are located deep to it, whereas the superficial nodes are superficial to the deep fascia.


Femoral artery
Femoral nerve
Femoral vein
Superficial fascia
Great saphenous vein

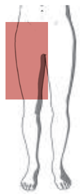
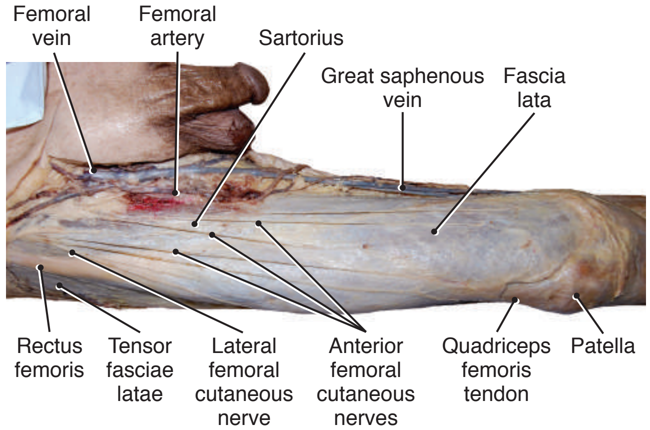


Fig. 17.15 Fat cleaned away around saphenous vein, with dissection extended medially and laterally.


Femoral vein
Femoral artery
Sartorius
Great saphenous vein
Fascia lata
Rectus femoris
Tensor fasciae latae
Lateral femoral cutaneous nerve
Anterior femoral cutaneous nerves
Quadriceps femoris tendon
Patella

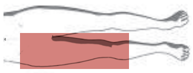


Fig. 17.16 Appreciate anterior cutaneous branches of femoral nerve intermingled with tributaries of great saphenous vein and rectus femoris muscle with lateral femoral cutaneous nerve.

- Cut the distal ends of the cutaneous nerves you previously dissected.
- Reflect the nerves medially and preserve them.
- Cut the deep fascia of the thigh, *fascia lata,* and expose the sartorius muscle (Fig. 17.17).
- Continue reflecting the fascia lata over the vastus medialis muscle (Fig. 17.18).
- Expose the quadriceps femoris muscles of the extensor compartment of the thigh; the vastus medialis, lateralis, and intermedius muscles; and the rectus femoris muscle and their tendons attaching to the patella.
- Continue the exposure by noting the fascia lata laterally and its thickened distal part, the *iliotibial tract,* attaching to the lateral condyle of the tibia (Fig. 17.19).
- Reflect the rectus femoris muscle medially, and expose the vastus intermedius muscle underneath (Fig. 17.20).
- Place the cutaneous nerves back in their original position over the dissected muscles, and appreciate their location (Fig. 17.21).

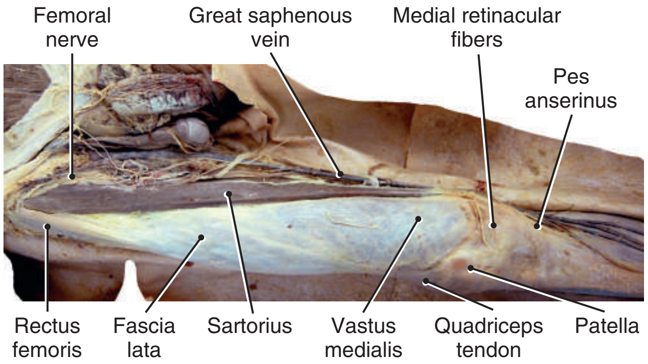
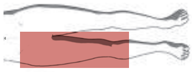

Femoral nerve
Great saphenous vein
Medial retinacular fibers
Pes anserinus
Rectus femoris
Fascia lata
Sartorius
Vastus medialis
Quadriceps tendon
Patella

Fig. 17.17 Distal ends of dissected cutaneous nerve reflected, with deep fascia (fascia lata) cut, exposing sartorius muscle.



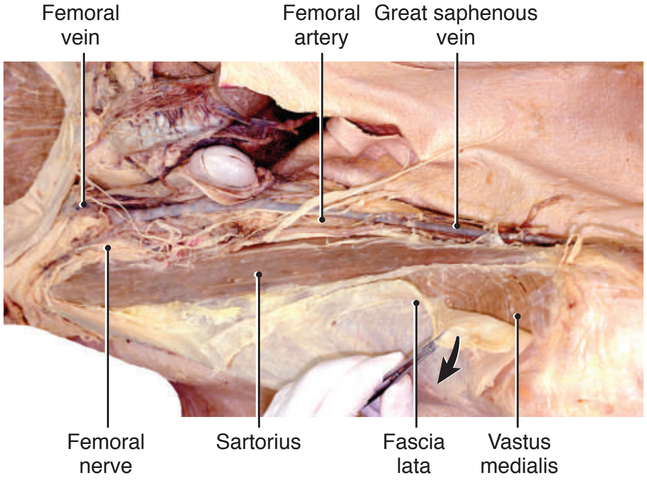
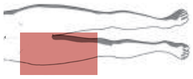

Femoral vein
Femoral artery
Great saphenous vein
Femoral nerve
Sartorius
Fascia lata
Vastus medialis

Fig. 17.18 View of fascia lata reflected over vastus medialis muscle.



- Expose the femoral vein, and dissect out the *cribriform fascia,* which fills the saphenous hiatus (Fig. 17.22).
- Cut the femoral sheath around the femoral artery and vein.
- Note the relationship between the femoral artery and vein; the femoral artery is located lateral to the femoral vein. The femoral nerve lies lateral to the femoral artery (Fig. 17.23).

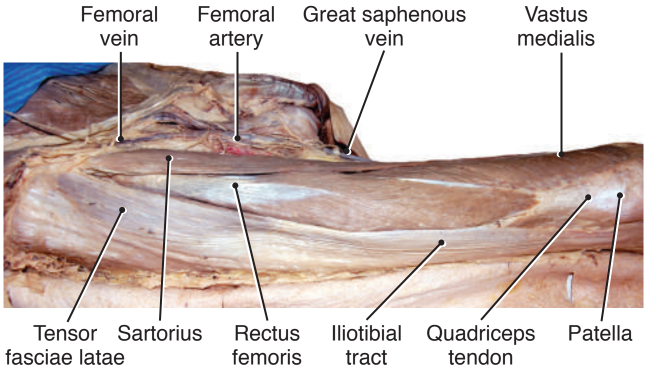
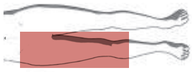

Femoral vein
Femoral artery
Great saphenous vein
Vastus medialis
Tensor fasciae latae
Sartorius
Rectus femoris
Iliotibial tract
Quadriceps tendon
Patella

Fig. 17.19 Exposed quadriceps femoris muscles of extensor compartment of thigh with tendon attaching to patella.



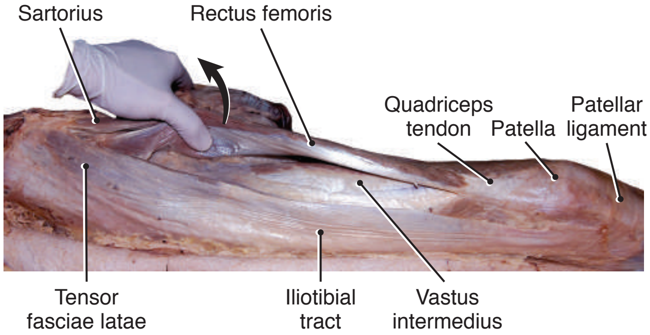
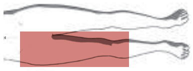

Sartorius
Rectus femoris
Quadriceps tendon
Patella
Patellar ligament
Tensor fasciae latae
Iliotibial tract
Vastus intermedius

Fig. 17.20 Rectus femoris muscle reflected medially, exposing vastus intermedius muscle.



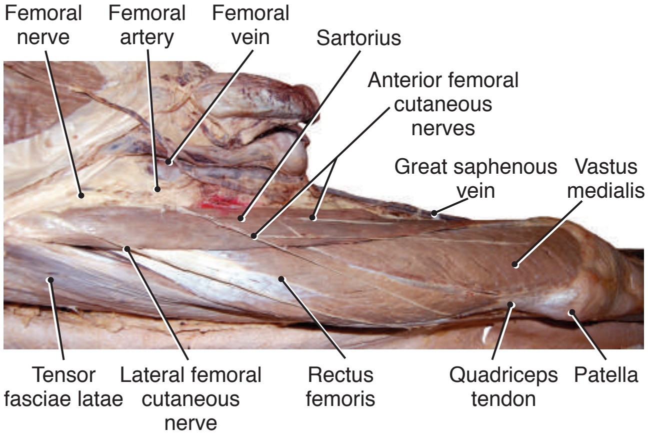
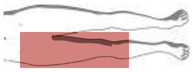

Femoral nerve
Femoral artery
Femoral vein
Sartorius
Anterior femoral cutaneous nerves
Great saphenous vein
Vastus medialis
Tensor fasciae latae
Lateral femoral cutaneous nerve
Rectus femoris
Quadriceps tendon
Patella

Fig. 17.21 Appreciate the position of the cutaneous nerves of the anterior thigh.



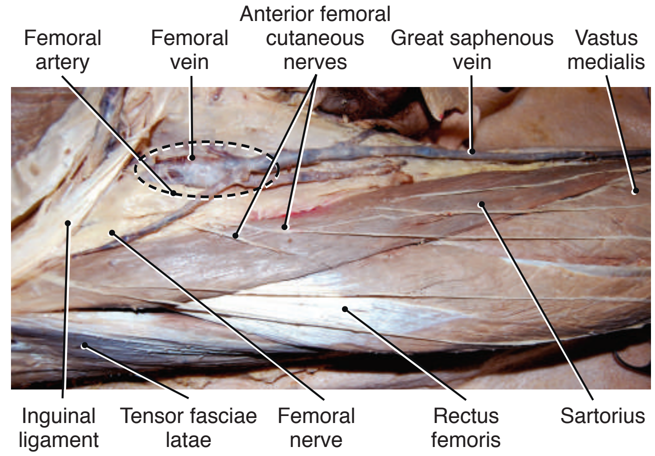
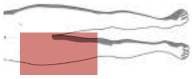

Anterior femoral cutaneous nerves
Femoral artery
Femoral vein
Great saphenous vein
Vastus medialis
Inguinal ligament
Tensor fasciae latae
Femoral nerve
Rectus femoris
Sartorius

Fig. 17.22 Femoral vein exposed, and the cribriform fascia that fills saphenous hiatus *(outlined oval)* is dissected.



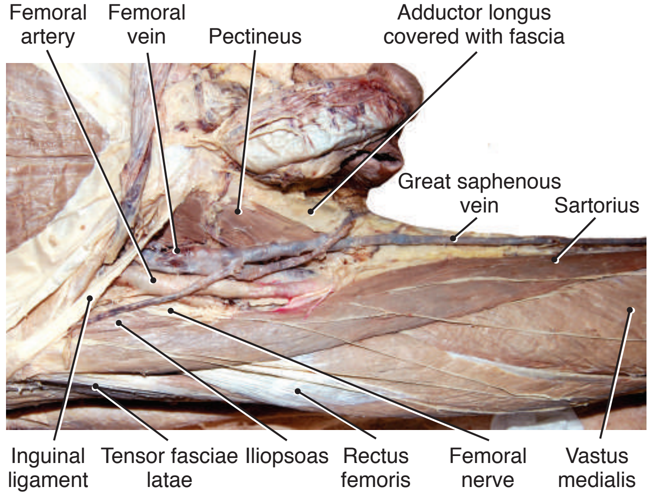
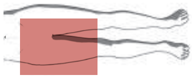

Femoral artery
Femoral vein
Pectineus
Adductor longus covered with fascia
Great saphenous vein
Sartorius
Inguinal ligament
Tensor fasciae latae
Iliopsoas
Rectus femoris
Femoral nerve
Vastus medialis

Fig. 17.23 Femoral sheath incised around femoral artery and vein to appreciate their relationship.



- Clean the fascia covering the femoral artery and vein, and trace these vessels underneath the inguinal ligament to the femoral triangle.
- Continue removing fat, and expose the adductor longus and gracilis muscles medially (Fig. 17.24).
- Retract the femoral artery laterally from the femoral vein, and deep between these vessels note the iliopsoas muscle lying over the anterior aspect of the hip joint (Fig. 17.25).

ANATOMY **NOTE**

The area you just dissected is called the *femoral triangle,* formed by the inguinal ligament superiorly, the sartorius muscle laterally, and the adductor longus muscle medially. The pectineus and iliopsoas muscles form the floor of the triangle (Plate 17.1).

- Cut the smaller venous tributaries draining to the femoral vein for better exposure of the femoral triangle.

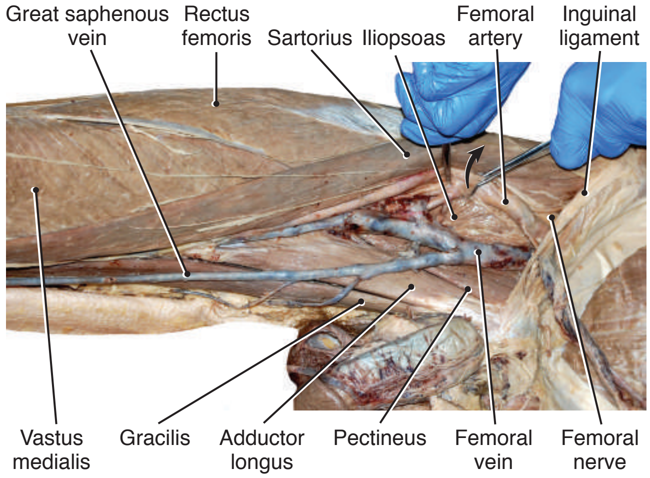
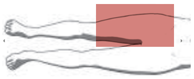

Great saphenous vein
Rectus femoris
Sartorius
Iliopsoas
Femoral artery
Inguinal ligament
Vastus medialis
Gracilis
Adductor longus
Pectineus
Femoral vein
Femoral nerve

Fig. 17.24 View of femoral artery and vein underneath inguinal ligament showing adductor longus and gracilis muscles.



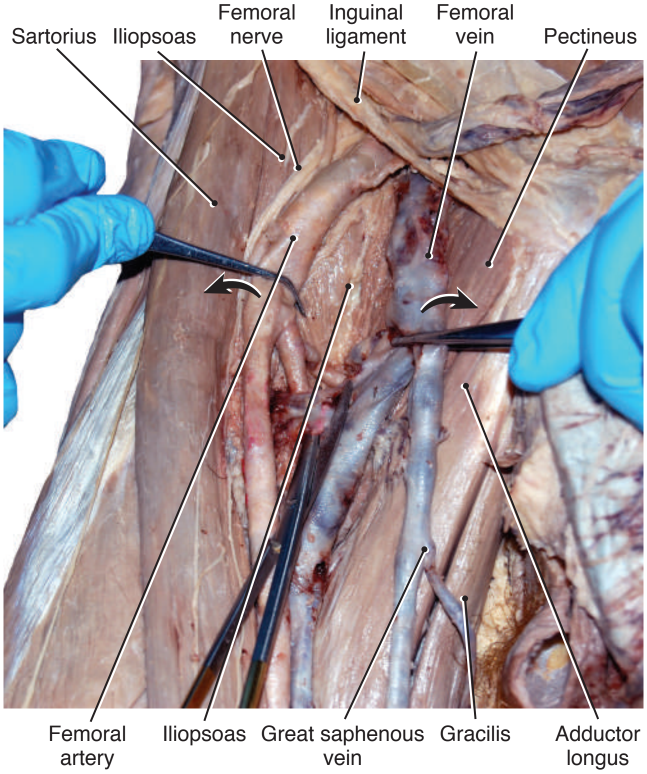
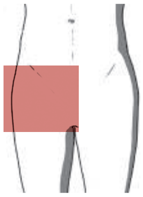

Sartorius
Iliopsoas
Femoral nerve
Inguinal ligament
Femoral vein
Pectineus
Femoral artery
Iliopsoas
Great saphenous vein
Gracilis
Adductor longus

Fig. 17.25 Femoral artery retracted laterally from femoral vein, highlighting deep-lying iliopsoas muscle over anterior aspect of capsule of hip joint.



- Medial to the iliopsoas muscle, note the pectineus muscle, and more medially, the adductor longus muscle.
- Clean the femoral artery and vein proximal to the femoral canal, and trace the lateral femoral cutaneous nerve underneath the inguinal ligament, just medial to the anterior superior iliac spine (Fig. 17.26).

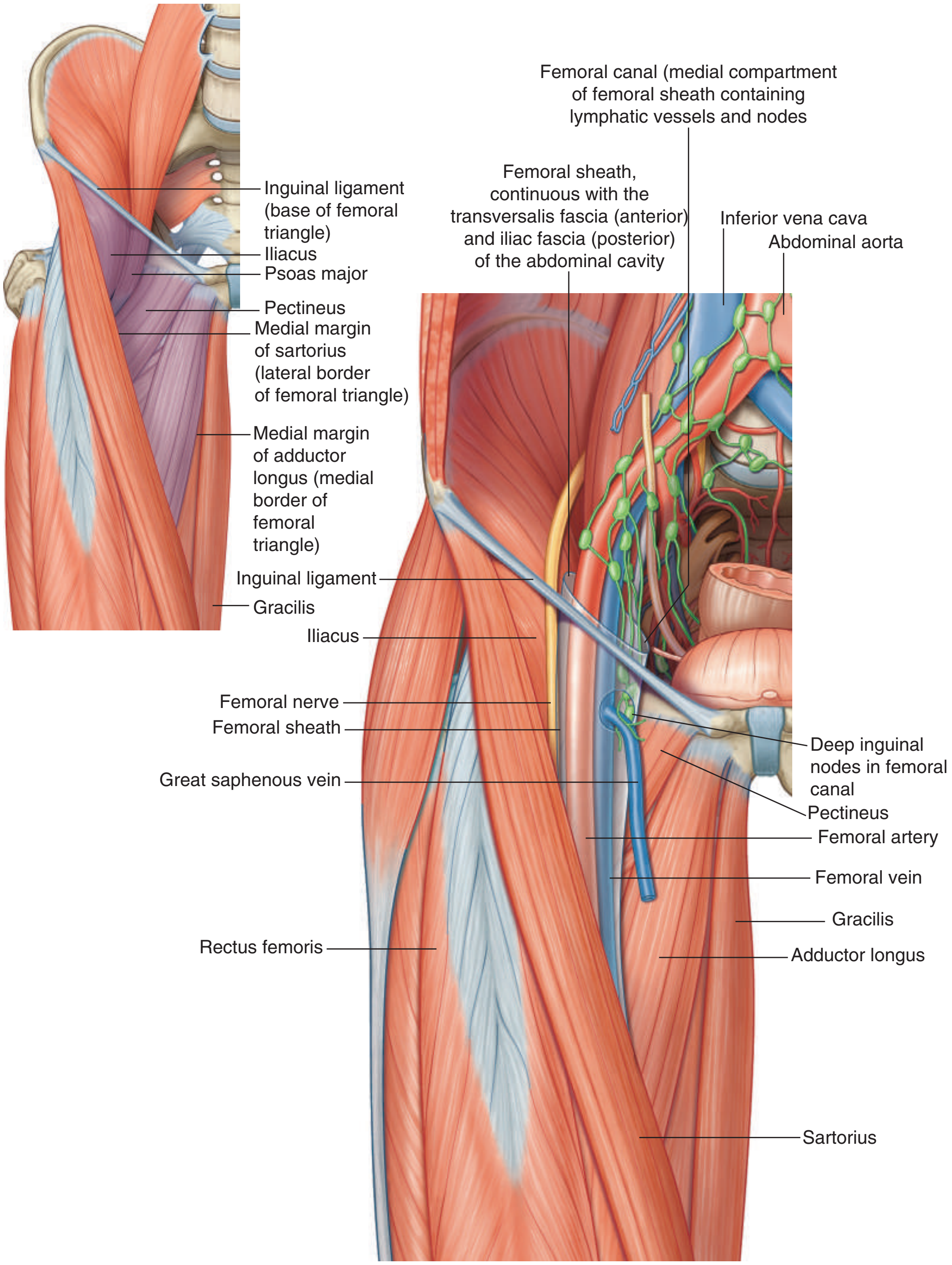

Inguinal ligament (base of femoral triangle)
Iliacus
Psoas major
Pectineus
Medial margin of sartorius (lateral border of femoral triangle)
Medial margin of adductor longus (medial border of femoral triangle)
Inguinal ligament
Gracilis
Femoral canal (medial compartment of femoral sheath containing lymphatic vessels and nodes
Femoral sheath, continuous with the transversalis fascia (anterior) and iliac fascia (posterior) of the abdominal cavity
Inferior vena cava
Abdominal aorta
Iliacus
Femoral nerve
Femoral sheath
Great saphenous vein
Deep inguinal nodes in femoral canal
Pectineus
Femoral artery
Femoral vein
Gracilis
Adductor longus
Rectus femoris
Sartorius

Plate 17.1 Borders and contents of the femoral triangle.

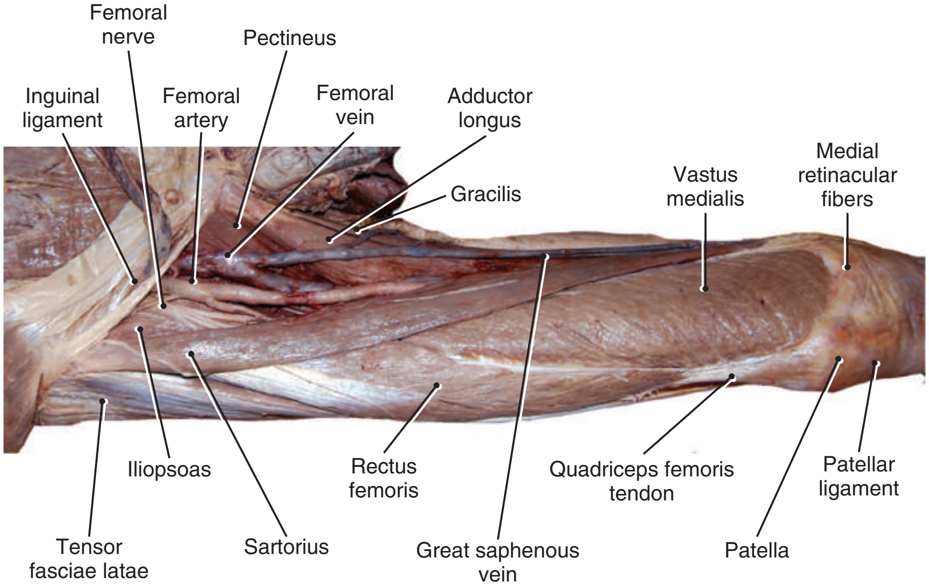
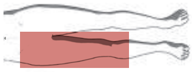

Femoral nerve
Pectineus
Inguinal ligament
Femoral artery
Femoral vein
Adductor longus
Gracilis
Vastus medialis
Medial retinacular fibers
Iliopsoas
Rectus femoris
Quadriceps femoris tendon
Patellar ligament
Tensor fasciae latae
Sartorius
Great saphenous vein
Patella

Fig. 17.26 Femoral artery and vein cleaned proximal to femoral canal, showing lateral femoral cutaneous nerve.



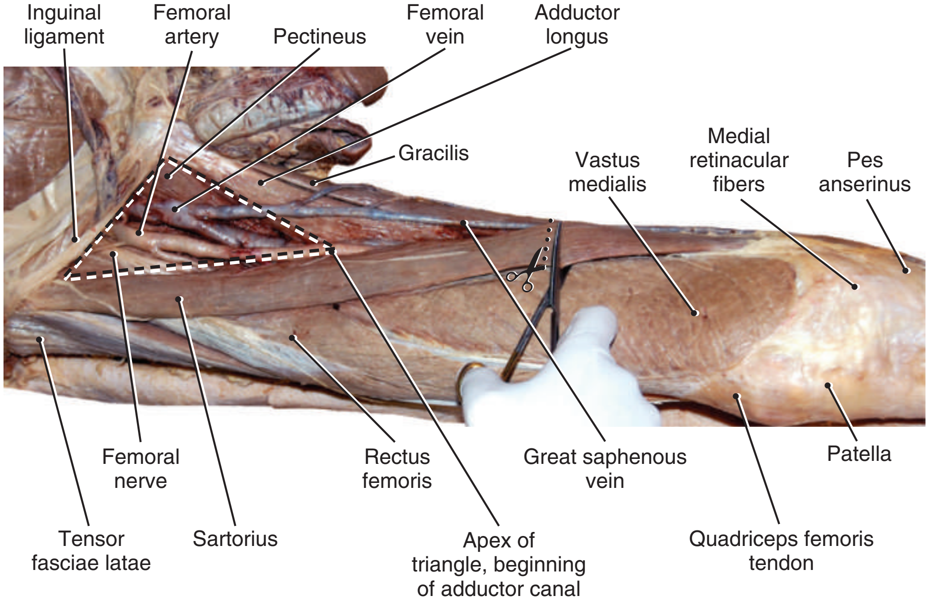
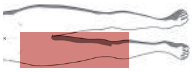

Inguinal ligament
Femoral artery
Pectineus
Femoral vein
Adductor longus
Gracilis
Vastus medialis
Medial retinacular fibers
Pes anserinus
Femoral nerve
Rectus femoris
Great saphenous vein
Patella
Tensor fasciae latae
Sartorius
Apex of triangle, beginning of adductor canal
Quadriceps femoris tendon

Fig. 17.27 Smaller tributaries draining the femoral vein cut to expose femoral triangle *(outline)* and appreciate the pectineus and adductor longus muscles.



- **Cut the sartorius muscle at its distal quarter, and expose the adductor canal (Figs. 17.27 and 17.28).**

ANATOMY **NOTE**

The adductor canal is formed by the adductor magnus, adductor longus, and vastus medialis muscles. The canal begins at the apex of the femoral triangle and ends at the adductor hiatus, which is the canal formed by the adductor magnus tendon at the posterior knee. After passing through the adductor hiatus and reaching the posterior part of the knee, the femoral artery and femoral vein are termed the *popliteal artery* and *popliteal vein* (Fig. 17.29).

- **Within the adductor canal, expose and identify the femoral artery, femoral vein, saphenous nerve, nerve to the vastus medialis muscle, and descending genicular artery (see Fig. 17.29).**
- **Expose the aperture in the tendon of insertion of the adductor magnus, the adductor hiatus (Fig. 17.30).**
- **Identify the nerve to the vastus medialis muscle, and trace the nerve to its termination on the muscle.**
- **Distal to the level of the adductor hiatus, trace the saphenous nerve and expose it to the posteromedial aspect of the knee where it meets the great saphenous vein.**

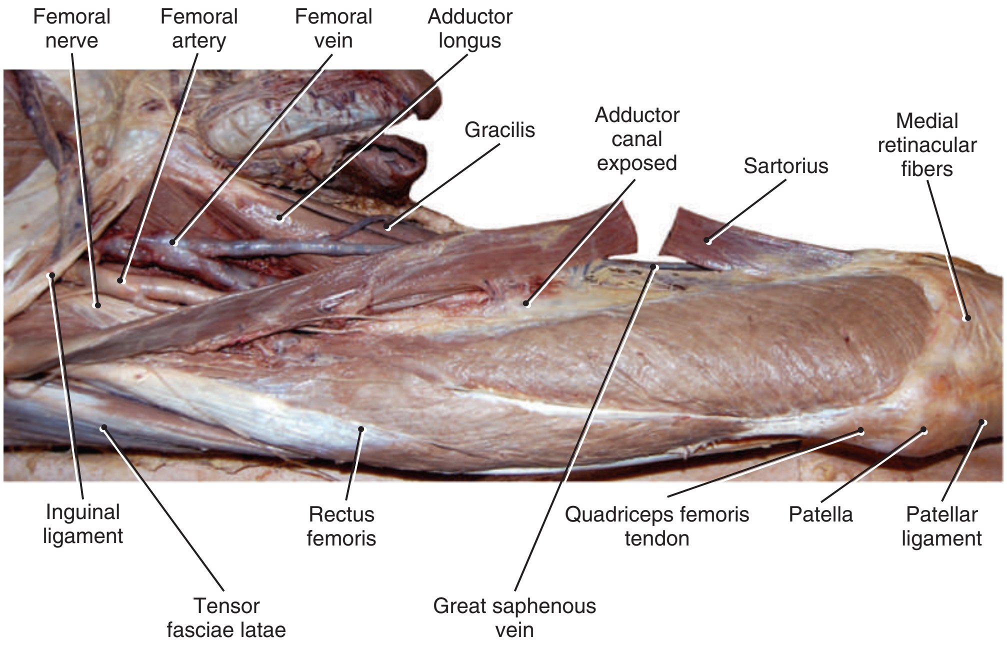
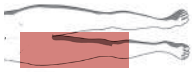

Femoral nerve
Femoral artery
Femoral vein
Adductor longus
Gracilis
Adductor canal exposed
Sartorius
Medial retinacular fibers
Inguinal ligament
Rectus femoris
Quadriceps femoris tendon
Patella
Patellar ligament
Tensor fasciae latae
Great saphenous vein

Fig. 17.28 View of cut sartorius muscle, exposing adductor canal.



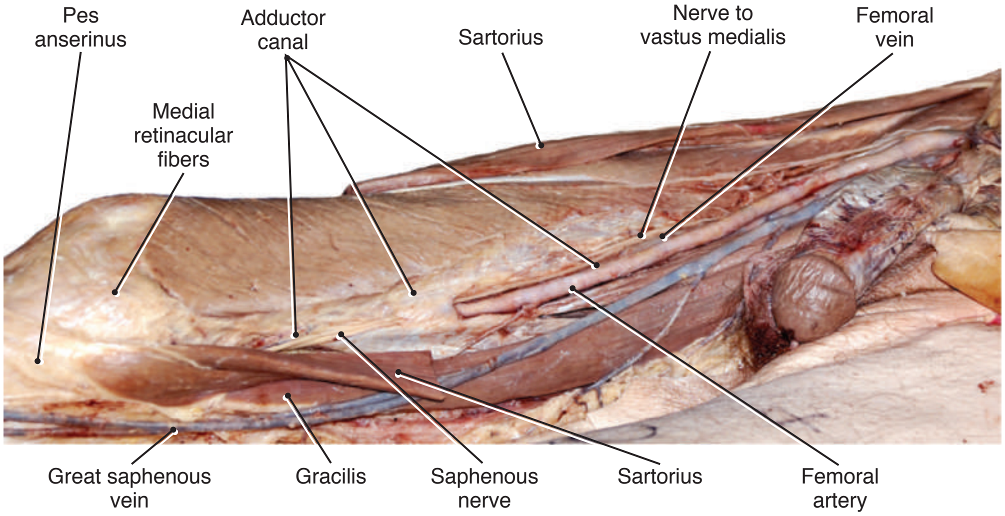
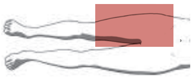

Pes anserinus
Adductor canal
Sartorius
Nerve to vastus medialis
Femoral vein
Medial retinacular fibers
Great saphenous vein
Gracilis
Saphenous nerve
Sartorius
Femoral artery

Fig. 17.29 View of femoral artery and vein, saphenous nerve, nerve to vastus medialis muscle, and descending genicular artery within adductor canal.



- With scissors, cut the femoral vein a few centimeters inferior to the femoral canal and reflect it inferiorly (Figs. 17.31 and 17.32).
- Fully expose the pectineus, adductor longus, and gracilis muscles.
- Pull the femoral artery medially, and dissect out its branches (Figs. 17.33 and 17.34).
- Identify the lateral circumflex femoral artery, and expose its descending branch supplying the vastus lateralis, which travels in the muscle between the vastus lateralis and vastus intermedius (this is a fairly constant dissection landmark).

ANATOMY **NOTE**

The lateral circumflex femoral artery also gives off several perforating branches to the vastus intermedius.

- Continue the dissection by exposing the deep femoral artery *(profunda femoris)* deep to the adductor longus muscle (see Figs. 17.33 and 17.34, Plate 17.2).
- Expose several of the perforating branches mainly supplying the posterior compartment of the thigh.
- Identify the medial circumflex femoral artery, and expose it between the iliopsoas and pectineus muscles.

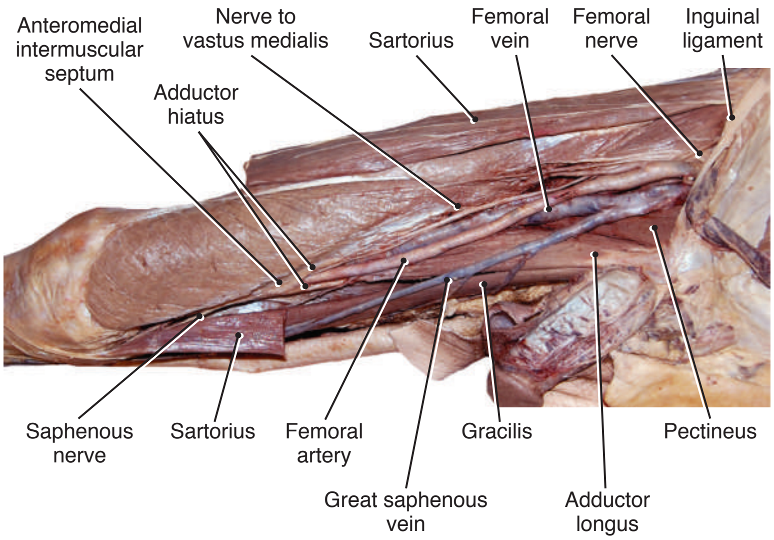
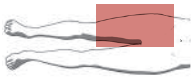

Anteromedial intermuscular septum
Nerve to vastus medialis
Adductor hiatus
Sartorius
Femoral vein
Femoral nerve
Inguinal ligament
Saphenous nerve
Sartorius
Femoral artery
Great saphenous vein
Gracilis
Adductor longus
Pectineus

Fig. 17.30 View of adductor hiatus, the aperture in the tendon of insertion of the adductor magnus muscle.



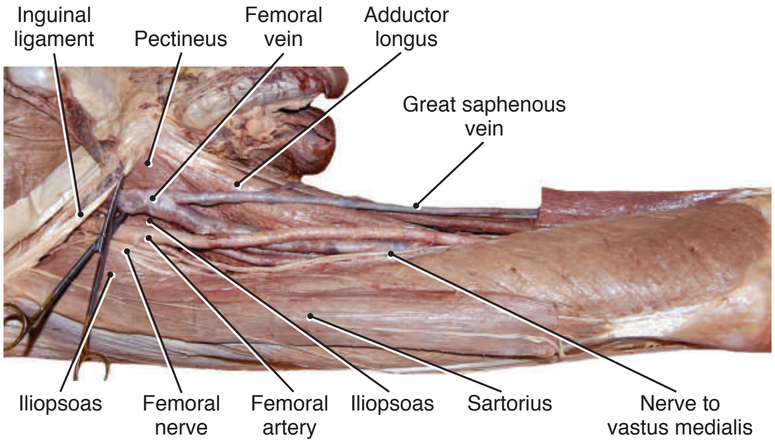
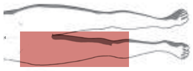

Inguinal ligament
Pectineus
Femoral vein
Adductor longus
Great saphenous vein
Iliopsoas
Femoral nerve
Femoral artery
Iliopsoas
Sartorius
Nerve to vastus medialis

Fig. 17.31 View of musculature with femoral vein incised inferior to the femoral canal.



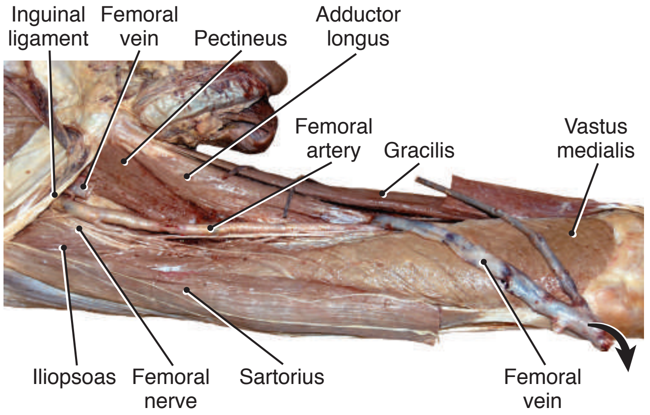
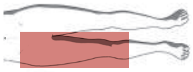

Inguinal ligament
Femoral vein
Pectineus
Adductor longus
Femoral artery
Gracilis
Vastus medialis
Iliopsoas
Femoral nerve
Sartorius
Femoral vein

Fig. 17.32 View with femoral vein reflected inferiorly.



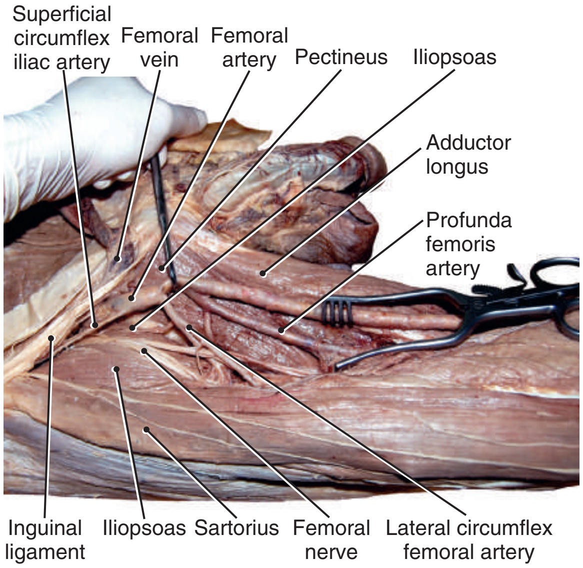
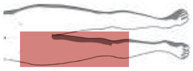

Superficial circumflex iliac artery
Femoral vein
Femoral artery
Pectineus
Iliopsoas
Adductor longus
Profunda femoris artery
Inguinal ligament
Iliopsoas
Sartorius
Femoral nerve
Lateral circumflex femoral artery

Fig. 17.33 Femoral artery pulled medially and its branches dissected.



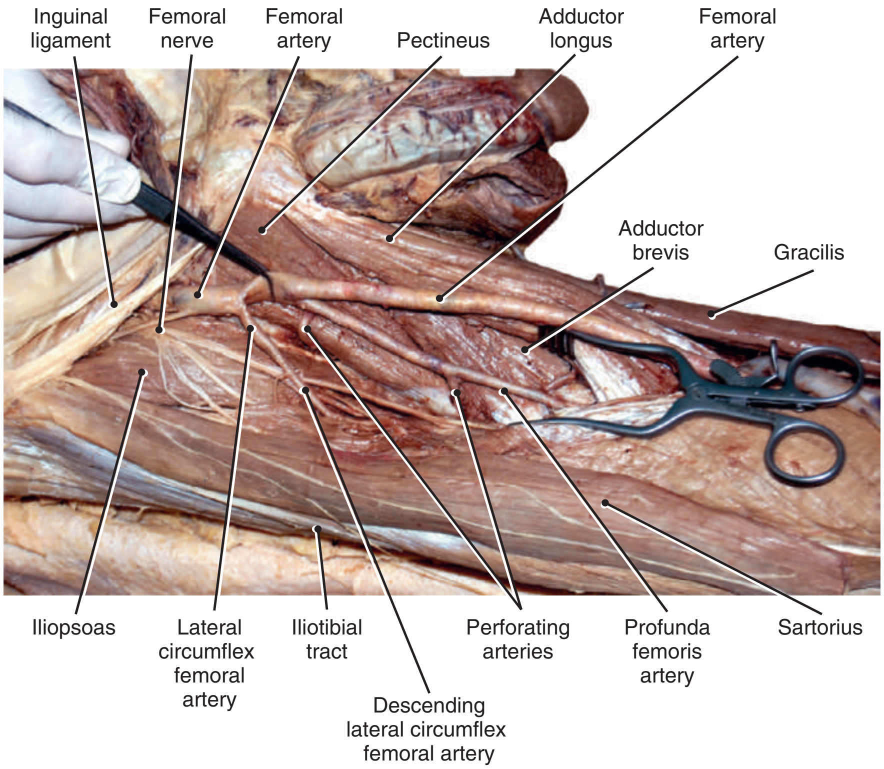
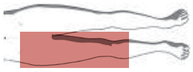


Fig. 17.34 Appreciate the lateral circumflex femoral artery and its descending branch.



DISSECTION TIP

If it is large enough, dissect out the transverse branch of the lateral circumflex femoral artery running to the posterior surface of the femur below the greater trochanter and contributing to the so-called cruciate anastomosis. Look for an ascending branch from the lateral circumflex femoral artery that runs upward to anastomose with the deep circumflex iliac and superior gluteal arteries. In some specimens, a retractor is useful to retract the tissues between the adductor longus and vastus intermedius muscles.

DISSECTION TIP

Remember that an artery's name is based on its distribution, not its origin. The lateral circumflex femoral, medial circumflex femoral, and deep femoral arteries commonly originate from a common trunk.

If time permits, from the exposed femoral artery, look for the following arteries:

- Superficial circumflex iliac artery, which travels toward the anterior superior iliac spine.
- Superficial epigastric artery, which travels upward toward the anterior abdominal wall, crossing over the inguinal canal.
- Superficial and deep external pudendal vessels typically are small arteries that anastomose with branches of the internal pudendal artery. Do not attempt to identify these two vessels.

ANATOMY NOTE

The so-called cruciate anastomosis classically involves the confluence of four arteries posterior to the upper part of the femur: (1) the transverse branch of the lateral circumflex femoral artery, (2) the medial circumflex femoral artery, (3) the descending branch of the inferior gluteal artery, and (4) the ascending branch of the first perforating artery.

DISSECTION TIP

From personal observations, the *transverse* branch of the lateral circumflex femoral artery is only rarely significant in this anastomosis, although the *ascending* branch does participate. Actually, the transverse branch of the lateral circumflex femoral artery may be very small or absent.

ANATOMY NOTE

Anastomoses around the hip also involve other vessels such as the superior gluteal, iliolumbar, deep circumflex iliac, ascending branch of the lateral circumflex femoral, and the obturator arteries. Therefore, with occlusion of the femoral artery, many possible routes can form collateral circulation from the iliac arteries to the lower extremity.

- In the space between the adductor longus and vastus intermedius muscles, identify the adductor brevis muscle (Fig. 17.35).
- With scissors, cut the pectineus muscle just inferior to the inguinal ligament, and reflect it laterally (Fig. 17.36).

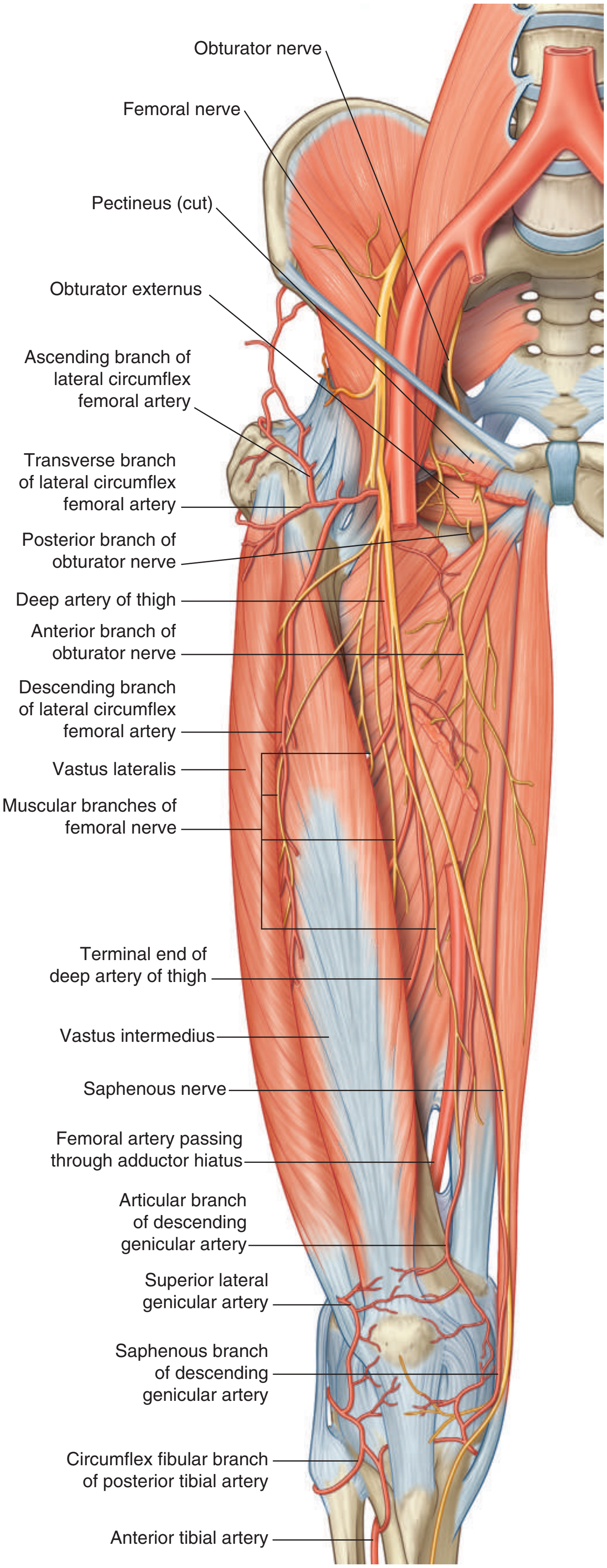

Obturator nerve
Femoral nerve
Pectineus (cut)
Obturator externus
Ascending branch of lateral circumflex femoral artery
Transverse branch of lateral circumflex femoral artery
Posterior branch of obturator nerve
Deep artery of thigh
Anterior branch of obturator nerve
Descending branch of lateral circumflex femoral artery
Vastus lateralis
Muscular branches of femoral nerve
Terminal end of deep artery of thigh
Vastus intermedius
Saphenous nerve
Femoral artery passing through adductor hiatus
Articular branch of descending genicular artery
Superior lateral genicular artery
Saphenous branch of descending genicular artery
Circumflex fibular branch of posterior tibial artery
Anterior tibial artery

Plate 17.2 Deep arteries and nerves of the thigh.

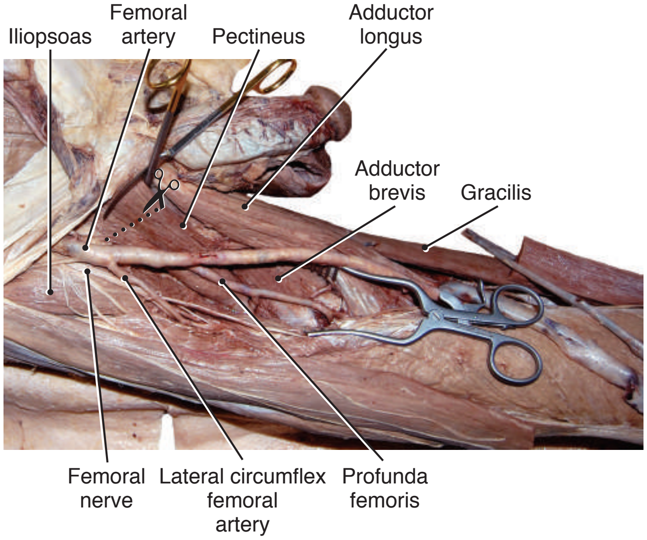

Iliopsoas
Femoral artery
Pectineus
Adductor longus
Adductor brevis
Gracilis
Femoral nerve
Lateral circumflex femoral artery
Profunda femoris

Fig. 17.35 Appreciate the adductor brevis muscle in space between adductor longus and vastus intermedius muscles.

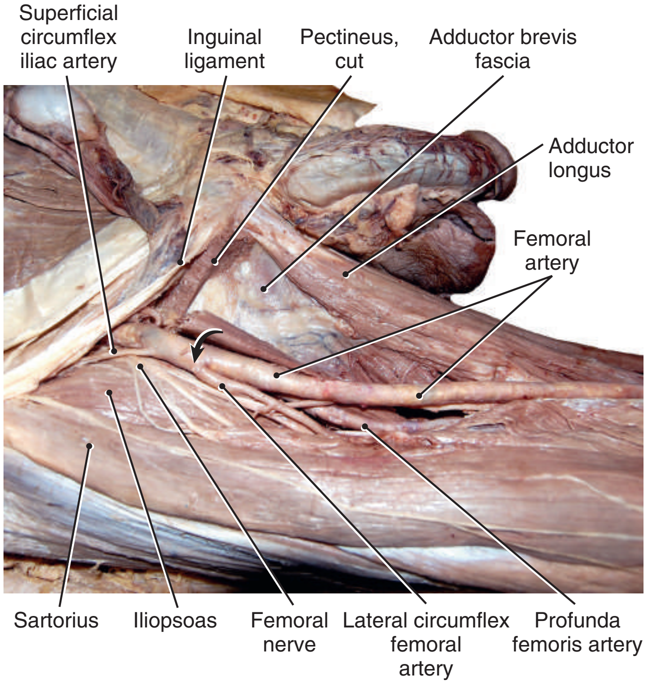

Superficial circumflex iliac artery
Inguinal ligament
Pectineus, cut
Adductor brevis fascia
Adductor longus
Femoral artery
Sartorius
Iliopsoas
Femoral nerve
Lateral circumflex femoral artery
Profunda femoris artery

Fig. 17.36 View with pectineus muscle incised inferior to the inguinal ligament and reflected laterally.

- Note the adductor brevis fascia over the proximal part of the adductor brevis muscle. Remove the fascia carefully, and expose the obturator artery and nerve (Figs. 17.37 and 17.38).

ANATOMY **NOTE**

The *obturator nerve* splits into two divisions: anterior and posterior. The *anterior division* courses anterior to the adductor brevis to innervate the adductor longus and brevis muscles.

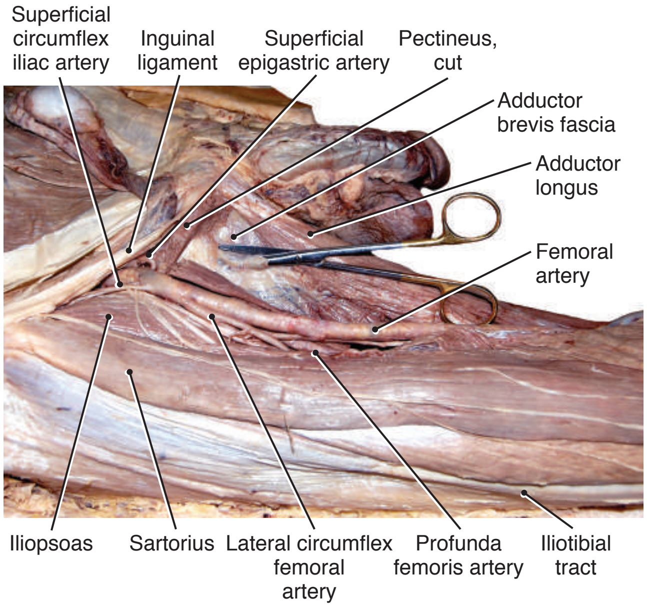
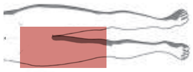

Superficial circumflex iliac artery
Inguinal ligament
Superficial epigastric artery
Pectineus, cut
Adductor brevis fascia
Adductor longus
Femoral artery
Iliopsoas
Sartorius
Lateral circumflex femoral artery
Profunda femoris artery
Iliotibial tract

Fig. 17.37 Adductor brevis fascia removed, exposing obturator artery and nerve.



- Reflect the adductor brevis muscle laterally, and identify the *posterior division* of the obturator nerve innervating the adductor magnus.

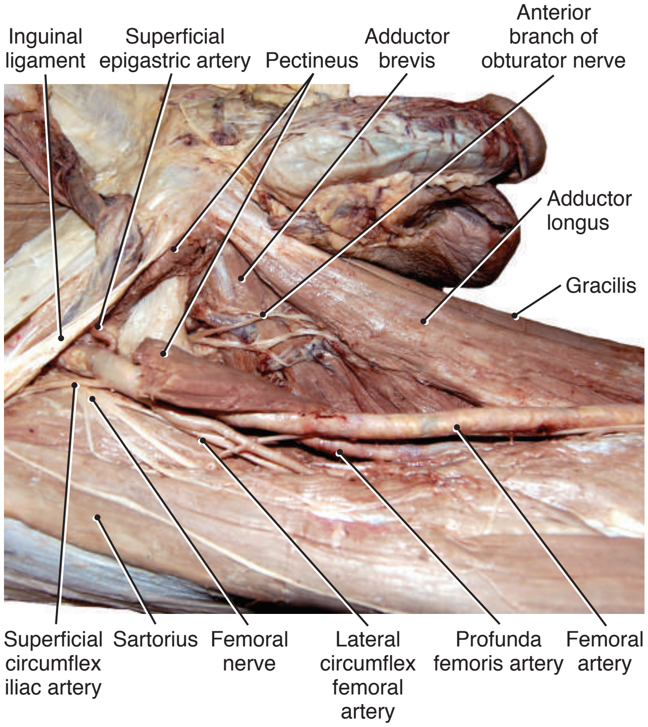
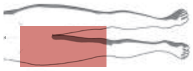

Inguinal ligament
Superficial epigastric artery
Pectineus
Adductor brevis
Anterior branch of obturator nerve
Adductor longus
Gracilis
Superficial circumflex iliac artery
Sartorius
Femoral nerve
Lateral circumflex femoral artery
Profunda femoris artery
Femoral artery

Fig. 17.38 Adductor brevis muscle reflected laterally, revealing posterior division of obturator nerve.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Femoral
  - ☐ Branch to vastus medialis
  - ☐ Branch to rectus femoris
  - ☐ Branch to vastus lateralis
  - ☐ Branch to vastus intermedius
  - ☐ Saphenous
- ☐ Lateral femoral cutaneous
- ☐ Obturator
  - ☐ Anterior division
  - ☐ Posterior division
- ☐ Sciatic
  - ☐ Tibial
  - ☐ Common fibular
- ☐ Posterior cutaneous, of thigh

ARTERIES

- ☐ Femoral
- ☐ Superficial epigastric
- ☐ Superficial circumflex iliac
- ☐ Superficial external pudendal
- ☐ Deep external pudendal
- ☐ Profunda femoris
- ☐ Medial circumflex femoral
- ☐ Lateral circumflex femoral
- ☐ Perforating arteries
- ☐ Descending genicular
- ☐ Popliteal
- ☐ Superior genicular arteries
- ☐ Middle genicular
- ☐ Inferior genicular arteries
- ☐ Obturator
  - ☐ Acetabular branch

VEINS

- ☐ Great saphenous
- ☐ Small (lesser) saphenous
- ☐ Superficial epigastric
- ☐ Superficial circumflex iliac
- ☐ External pudendal
- ☐ Popliteal
- ☐ Profunda femoris
- ☐ Femoral

CONNECTIVE TISSUE

- ☐ Femoral fascia (fascia lata)
- ☐ Anteromedial intermuscular septum
- ☐ Medial intermuscular septum
- ☐ Lateral intermuscular septum
- ☐ Posterior intermuscular septum
- ☐ Vastoadductor membrane

LIGAMENTS

- ☐ *Hip*
  - ☐ Iliofemoral
  - ☐ Pubofemoral
  - ☐ Ischiofemoral
  - ☐ Ligamentum teres
  - ☐ Acetabular labrum/transverse acetabular
- ☐ *Knee*
  - ☐ Anterior cruciate
  - ☐ Posterior cruciate
  - ☐ Transverse
  - ☐ Tibial collateral
- ☐ Fibular (lateral) collateral
- ☐ Oblique popliteal

CARTILAGE

- ☐ Medial meniscus
- ☐ Lateral meniscus

MUSCLES

Anterior Compartment (Extensor Compartment)

- ☐ Sartorius
- ☐ Iliopsoas
- ☐ Iliacus
- ☐ Rectus femoris
- ☐ Vastus medialis
- ☐ Vastus lateralis
- ☐ Vastus intermedius
- ☐ Articularis genus

Femoral Triangle

- ☐ Borders
  - ☐ Inguinal ligament, superior border
  - ☐ Adductor longus, medial border
  - ☐ Sartorius, lateral border
- ☐ Floor
  - ☐ Iliacus
  - ☐ Psoas
  - ☐ Pectineus
- ☐ Contents (medial to lateral)
  - ☐ Femoral canal with lymphatics
  - ☐ Femoral vein
  - ☐ Femoral artery
  - ☐ Femoral nerve

Adductor Canal (Subsartorial, or Hunter's Canal)

Extends from femoral triangle apex to adductor hiatus

- ☐ Contents
  - ☐ Femoral artery
  - ☐ Femoral vein
  - ☐ Nerve to vastus medialis
  - ☐ Saphenous nerve
  - ☐ Descending genicular

Tendons/Retinacula

- ☐ Quadriceps femoris tendon
- ☐ Patellar ligament
- ☐ Medial retinaculum
- ☐ Lateral retinaculum

Medial Compartment (Adductor Compartment)

- ☐ Gracilis
- ☐ Pectineus
- ☐ Obturator externus
- ☐ Adductor longus
- ☐ Adductor brevis
- ☐ Adductor magnus
- ☐ Femoral head
- ☐ Ischial or hamstring head
- ☐ Adductor minimus

POSTERIOR COMPARTMENT (FLEXOR COMPARTMENT)

- ☐ Biceps femoris
  - ☐ Long head
  - ☐ Short head
- ☐ Semitendinosus muscle
- ☐ Semimembranosus muscle

Pes anserinus

- ☐ Sartorius
- ☐ Gracilis
- ☐ Semitendinosus

BURSAE

- ☐ Suprapatellar
- ☐ Prepatellar
- ☐ Infrapatellar

BONES

- ☐ Coxal (hip bone)
- ☐ Femur
- ☐ Patella
- ☐ Proximal tibia
- ☐ Proximal fibula

CHAPTER 18 LEG AND ANKLE

ATLAS REFERENCES

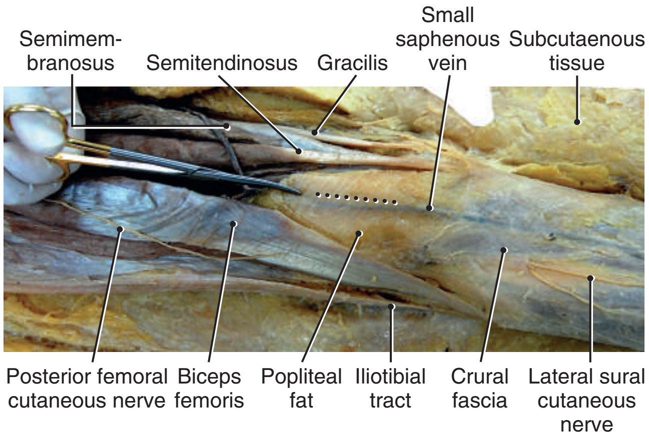
Netter: 495–514
McMinn: 328–343
Gray's Atlas: 318–329, 339–347

BEFORE YOU BEGIN

Identify the great and small (lesser) saphenous veins and the saphenous and sural nerves, from the previous dissection of the thigh and leg in Chapter 17.

POSTERIOR LEG

- ○ **Insert scissors or a probe between the semitendinosus and biceps femoris muscles into the popliteal fossa, and remove the superficial adipose tissue (Fig. 18.1).**
- ○ **Insert scissors or a probe underneath the crural fascia (Fig. 18.2), and divide the fascia into two parts.**
- ○ **Reflect the semitendinosus and biceps femoris muscles, and expose the contents of the popliteal fossa (Fig. 18.3). Note the sciatic nerve dividing into the tibial and common fibular nerves.**
- ○ Clean the fat and the lymphatics within the popliteal fossa and identify the following structures (Plate 18.1):
  - ○ Posterior femoral cutaneous nerve
  - ○ Small saphenous vein
  - ○ Tibial nerve
  - ○ Common fibular nerve
  - ○ Popliteal vein
  - ○ Popliteal artery


Semimem-branosus
Semitendinosus
Gracilis
Small saphenous vein
Subcutaenous tissue
Posterior femoral cutaneous nerve
Biceps femoris
Popliteal fat
Iliotibial tract
Crural fascia
Lateral sural cutaneous nerve

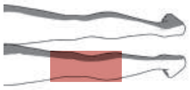
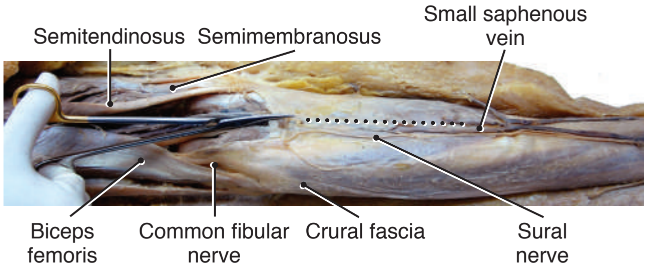


Fig. 18.1 Scissors inserted between semitendinosus and biceps femoris muscles, into popliteal fossa, with superficial adipose tissue removed.


Semitendinosus
Semimembranosus
Small saphenous vein
Biceps femoris
Common fibular nerve
Crural fascia
Sural nerve

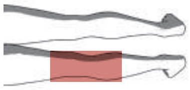


Fig. 18.2 *Dotted line* indicates crural fascia cut into two parts.

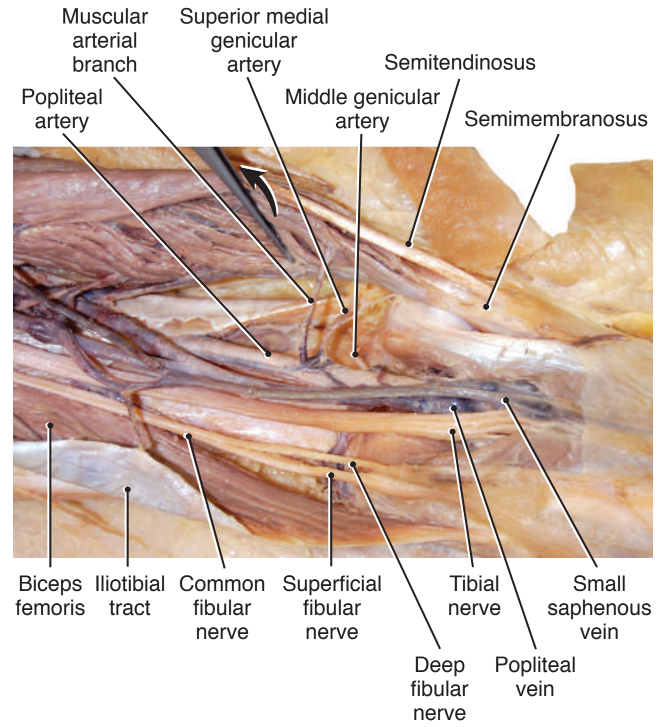
DISSECTION TIP

Identify the following landmarks (see also Chapter 17):

- The ***great saphenous vein*** and the saphenous nerve accompany each other along the medial aspect of the leg and thigh.
- The ***small saphenous vein*** and the sural nerve accompany each other along the posterior aspect of the leg. The small saphenous vein usually drains into the popliteal vein and often exhibits anastomoses with the great saphenous vein.
- The ***sural nerve*** is formed by the union of the medial sural cutaneous nerve, a branch of the tibial nerve, and a communicating branch of the lateral sural cutaneous nerve arising from the common fibular nerve. The sural nerve terminates as the ***lateral dorsal cutaneous nerve*** on the lateral foot.
- Clean the popliteal artery, and identify its division into **anterior and posterior tibial arteries**. Look for the popliteal artery's genicular branches, the superolateral, superomedial, inferolateral, inferomedial, and middle genicular arteries.
- To find the **superolateral and superomedial genicular arteries**; remove the fat just superior to the lateral and medial condyles of the femur, at the origin of the medial and lateral heads of the gastrocnemius muscle, respectively.
- The **middle genicular artery** is usually found arising from the anterior surface of the popliteal artery (deep from your view) just posterior to the knee joint.
- The **inferolateral genicular artery** is usually found underneath the lateral head of the gastrocnemius muscle.
- The **inferomedial genicular artery** is usually found underneath the medial head of the gastrocnemius muscle.

DISSECTION TIP

Do not try to identify every branch of the genicular arteries; some are too small. Similarly, exposing the anastomoses around the knee requires special preparation of the specimen (e.g., filling arteries with red latex).


Muscular arterial branch
Superior medial genicular artery
Semitendinosus
Popliteal artery
Middle genicular artery
Semimembranosus
Biceps femoris
Iliotibial tract
Common fibular nerve
Superficial fibular nerve
Tibial nerve
Small saphenous vein
Deep fibular nerve
Popliteal vein

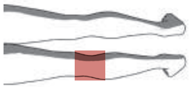


Fig. 18.3 Semitendinosus and biceps femoris muscles reflected laterally, exposing contents of the popliteal fossa.

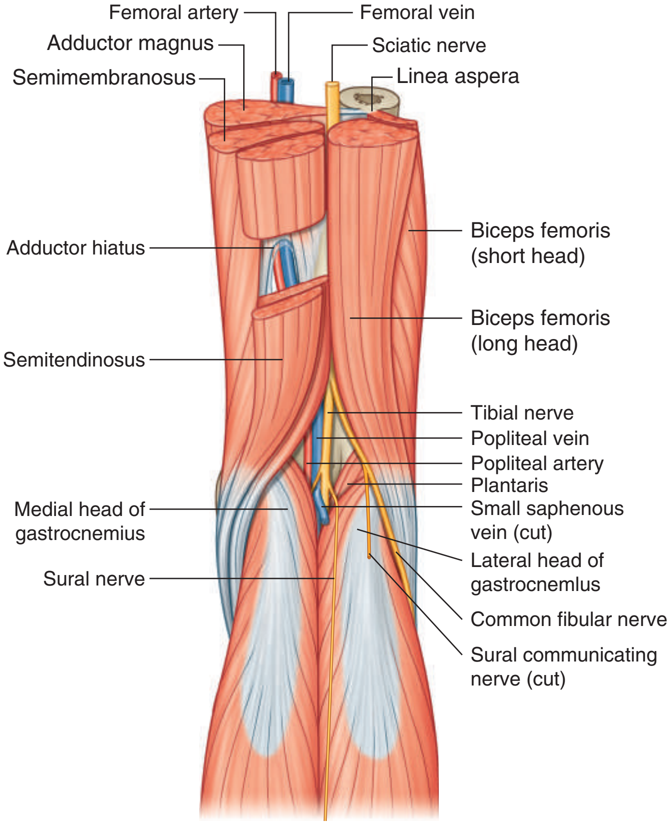
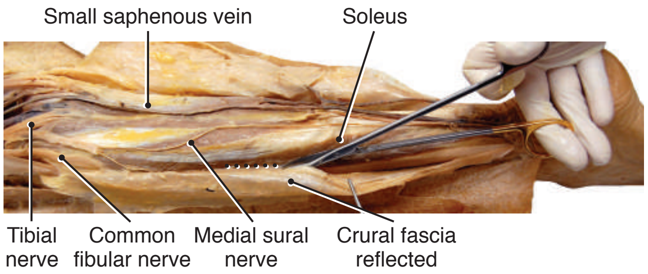

Femoral artery
Femoral vein
Adductor magnus
Sciatic nerve
Semimembranosus
Linea aspera
Adductor hiatus
Biceps femoris (short head)
Biceps femoris (long head)
Semitendinosus
Tibial nerve
Popliteal vein
Popliteal artery
Plantaris
Medial head of gastrocnemius
Small saphenous vein (cut)
Lateral head of gastrocnemlus
Sural nerve
Common fibular nerve
Sural communicating nerve (cut)

Plate 18.1 Structures in the popliteal fossa.


Small saphenous vein
Soleus
Tibial nerve
Common fibular nerve
Medial sural nerve
Crural fascia reflected

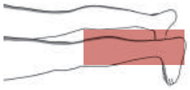
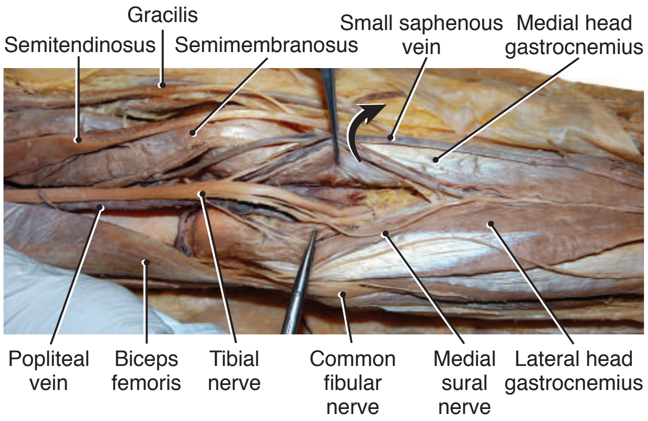


Fig. 18.4 Removing fascia, being careful not to disturb superficial veins and cutaneous nerves.


Gracilis
Semitendinosus
Semimembranosus
Small saphenous vein
Medial head gastrocnemius
Popliteal vein
Biceps femoris
Tibial nerve
Common fibular nerve
Medial sural nerve
Lateral head gastrocnemius

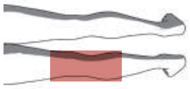
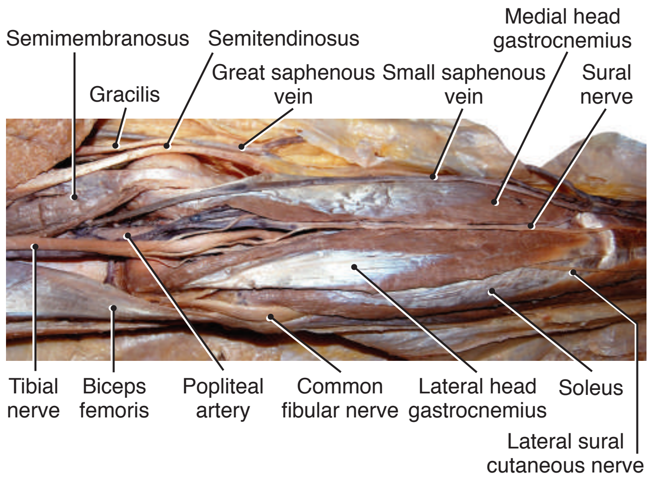


Fig. 18.5 Close-up view with medial and lateral heads of gastrocnemius muscle retracted laterally.

- **Completely remove the crural fascia from the underlying muscles of the posterior compartment of the leg, without disturbing the superficial veins and cutaneous nerves (Fig. 18.4).**
- **Identify the medial and lateral heads of the gastrocnemius muscle, and retract them laterally (Fig. 18.5).**
- **Trace the tibial nerve and identify its medial sural cutaneous branch (Fig. 18.6).**
- **Expose all the muscles of the posterior and lateral.**
- **Identify the common fibular nerve and trace its course from the thigh to the neck of the fibula compartments (Fig. 18.6).**
- **Separate the lateral head of the gastrocnemius muscle from the underlying soleus muscle (Fig. 18.7). Look for the *Achilles tendon,* the common tendon of the gastrocnemius and soleus muscles inserting onto the calcaneus.**
- **Preserve the lateral sural cutaneous nerve as you reflect the lateral head of the gastrocnemius. Similarly, preserve the medial sural cutaneous nerve and the tibial nerve as you reflect the medial head gastrocnemius muscle.**
- **Expose the underlying soleus muscle, and identify the tendon of the plantaris muscle on the posterior surface of the soleus.**


Semimembranosus
Semitendinosus
Medial head gastrocnemius
Gracilis
Great saphenous vein
Small saphenous vein
Sural nerve
Tibial nerve
Biceps femoris
Popliteal artery
Common fibular nerve
Lateral head gastrocnemius
Soleus
Lateral sural cutaneous nerve

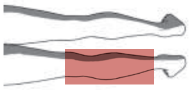
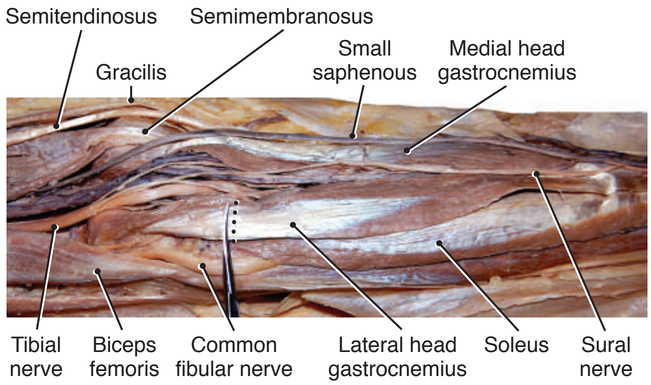


Fig. 18.6 Appreciate the tibial nerve and medial sural cutaneous branch as well as muscles of the posterior and lateral compartments of the leg.


Semitendinosus
Semimembranosus
Gracilis
Small saphenous
Medial head gastrocnemius
Tibial nerve
Biceps femoris
Common fibular nerve
Lateral head gastrocnemius
Soleus
Sural nerve

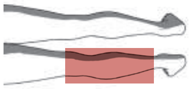
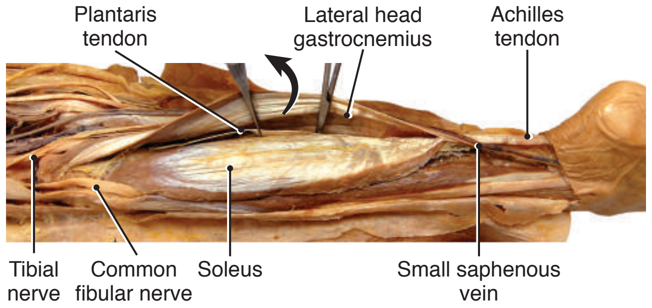


Fig. 18.8 Lateral head of gastrocnemius muscle cut at level of femoral condyle.


Plantaris tendon
Lateral head gastrocnemius
Achilles tendon
Tibial nerve
Common fibular nerve
Soleus
Small saphenous vein

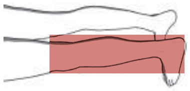
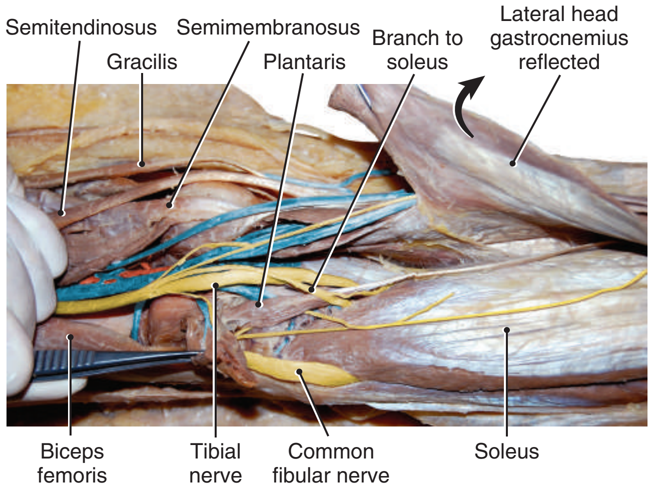


Fig. 18.7 The gastrocnemius muscle reflected, preserving the lateral and medial sural cutaneous nerves and the tibial nerve, and exposing the underlying soleus muscle and the tendon of the plantaris muscle on the posterior surface of the soleus muscle.


Semitendinosus
Semimembranosus
Gracilis
Plantaris
Branch to soleus
Lateral head gastrocnemius reflected
Biceps femoris
Tibial nerve
Common fibular nerve
Soleus

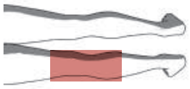
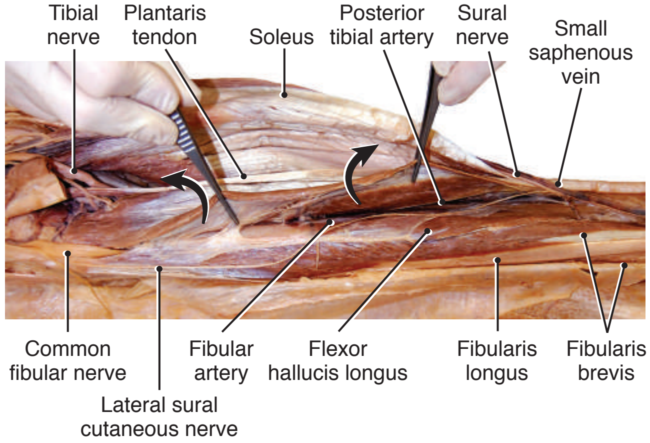


Fig. 18.9 Close-up view highlights muscle belly of plantaris muscle.


Tibial nerve
Plantaris tendon
Soleus
Posterior tibial artery
Sural nerve
Small saphenous vein
Common fibular nerve
Fibular artery
Flexor hallucis longus
Fibularis longus
Fibularis brevis
Lateral sural cutaneous nerve

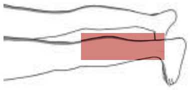


Fig. 18.10 Lateral border of soleus muscle detached from underlying fascia over flexor hallucis longus and flexor digitorum longus muscles.

- Cut the lateral head of the gastrocnemius at the level of the femoral condyle (Fig. 18.8).
- Reflect the lateral head of the gastrocnemius muscle medially, and expose the tendon of the **plantaris muscle**. Identify the muscle belly of the plantaris muscle (Fig. 18.9).
- Identify the branch from the tibial nerve, the **nerve to the soleus muscle.**
- With forceps, lift the lateral border of the soleus muscle and separate it from the underlying fascia over the **flexor hallucis longus** and **flexor digitorum longus muscles** (Fig. 18.10).
- With scissors, cut the soleus muscle close to its attachment to the tibia and fibula, and reflect it medially (Fig. 18.11).
- Clean the fascia and expose the **flexor hallucis longus** and **flexor digitorum longus muscles** as well as the

muscles of the lateral compartment of the leg, the **fibularis longus and fibularis brevis** (Fig. 18.12).

- Expose the **tibialis posterior muscle** as it travels along the posterior surface of the interosseous membrane to reach the bones of the foot (Fig. 18.13). Trace the division of the **common fibular nerve into deep and superficial fibular nerves** (Plate 18.2).

ANATOMY **NOTE**

The anterior tibial artery travels anterior to the interosseous membrane, whereas the posterior tibial artery gives rise to a fibular branch that travels to the lateral compartment and deep to the flexor hallucis longus muscle. Soon after arriving from the common fibular nerve, the superficial fibular nerve enters the lateral compartment of the leg.

KNEE

- **Place the cadaver in the supine position, and observe the knee joint. Identify the tendon of the quadriceps femoris muscle attaching to the patella.**

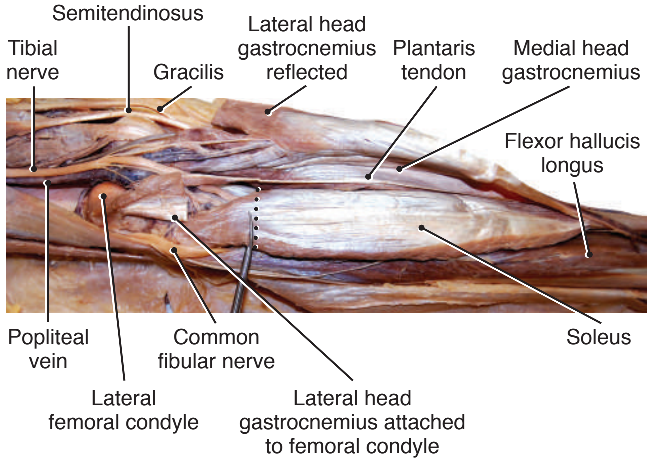
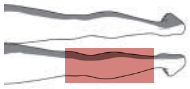

Semitendinosus
Tibial nerve
Gracilis
Lateral head gastrocnemius reflected
Plantaris tendon
Medial head gastrocnemius
Flexor hallucis longus
Popliteal vein
Common fibular nerve
Soleus
Lateral femoral condyle
Lateral head gastrocnemius attached to femoral condyle

Fig. 18.11 Soleus muscle cut proximal to tibiofibular attachment and reflected medially.



- Identify the **patellar ligament** and the strong, thick fascia on the medial and lateral sides of the knee joint, the ***medial and lateral retinacula*** of the knee (Fig. 18.14).
- Cut the medial and lateral retinacula, and expose the patellar ligament and the tendon of the quadriceps femoris muscle (Fig. 18.15).

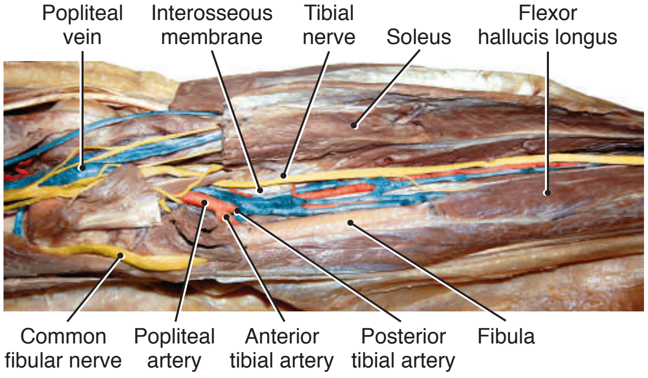
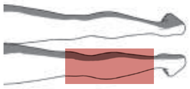

Popliteal vein
Interosseous membrane
Tibial nerve
Soleus
Flexor hallucis longus
Common fibular nerve
Popliteal artery
Anterior tibial artery
Posterior tibial artery
Fibula

Fig. 18.13 Tibialis posterior muscle exposed along posterior surface of interosseous membrane.



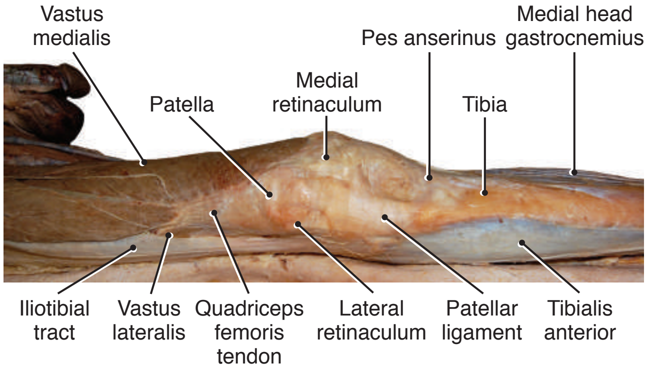
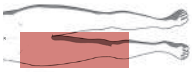

Vastus medialis
Medial head gastrocnemius
Pes anserinus
Patella
Medial retinaculum
Tibia
Iliotibial tract
Vastus lateralis
Quadriceps femoris tendon
Lateral retinaculum
Patellar ligament
Tibialis anterior

Fig. 18.14 Supine position, highlighting tendon of quadriceps femoris muscle, patellar ligament, and thick fascia on sides of knee joint (medial/lateral retinacula).



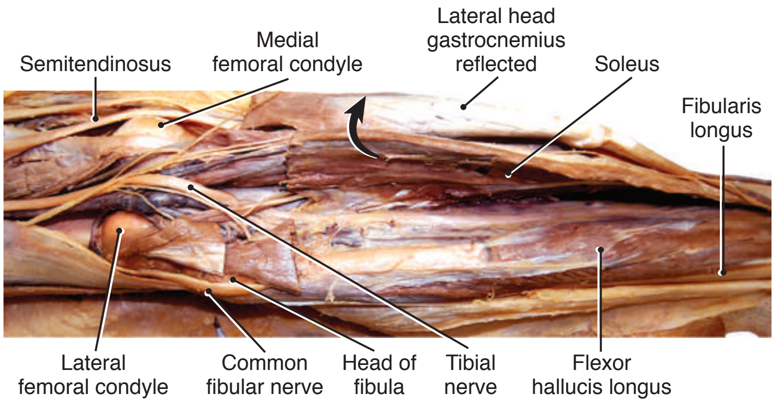
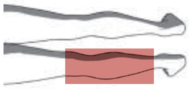

Lateral head gastrocnemius reflected
Medial femoral condyle
Semitendinosus
Soleus
Fibularis longus
Lateral femoral condyle
Common fibular nerve
Head of fibula
Tibial nerve
Flexor hallucis longus

Fig. 18.12 Fascia cleaned, exposing flexor hallucis longus, flexor digitorum longus, and lateral compartment muscles.



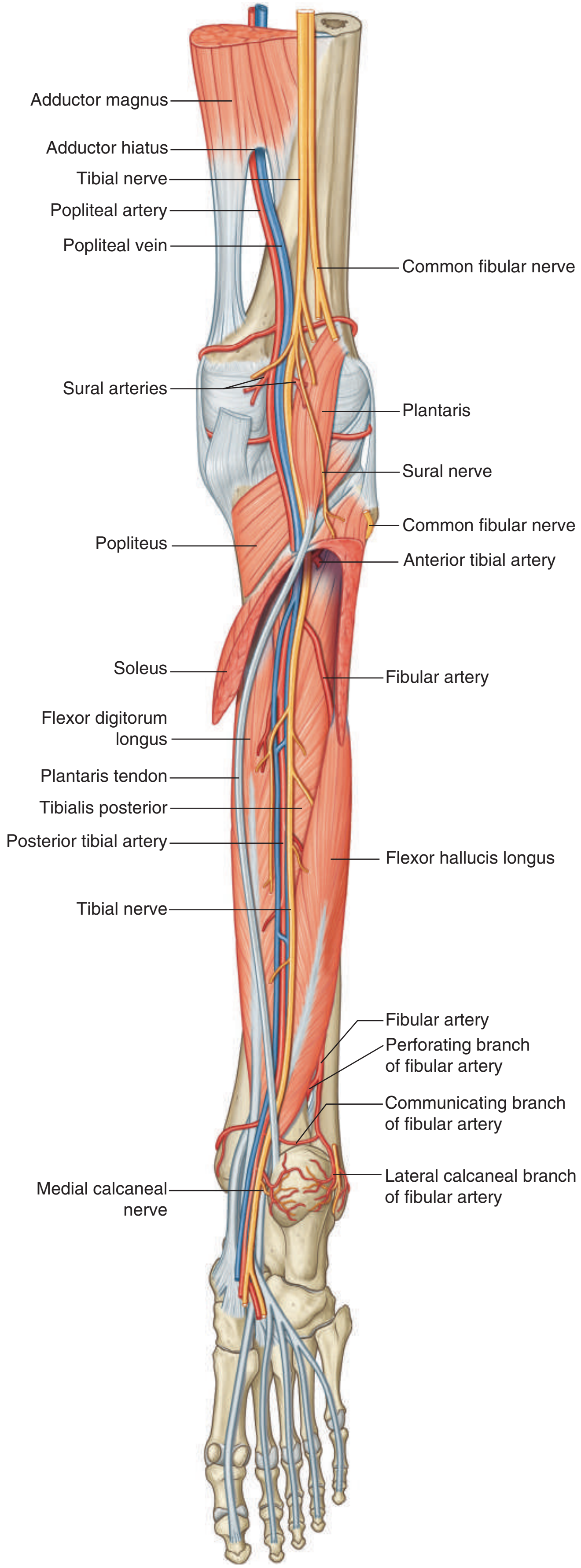

Adductor magnus
Adductor hiatus
Tibial nerve
Popliteal artery
Popliteal vein
Common fibular nerve
Sural arteries
Plantaris
Sural nerve
Common fibular nerve
Popliteus
Anterior tibial artery
Soleus
Fibular artery
Flexor digitorum longus
Plantaris tendon
Tibialis posterior
Posterior tibial artery
Flexor hallucis longus
Tibial nerve
Fibular artery
Perforating branch of fibular artery
Communicating branch of fibular artery
Lateral calcaneal branch of fibular artery
Medial calcaneal nerve

Plate 18.2 Arteries and nerves of the posterior leg.

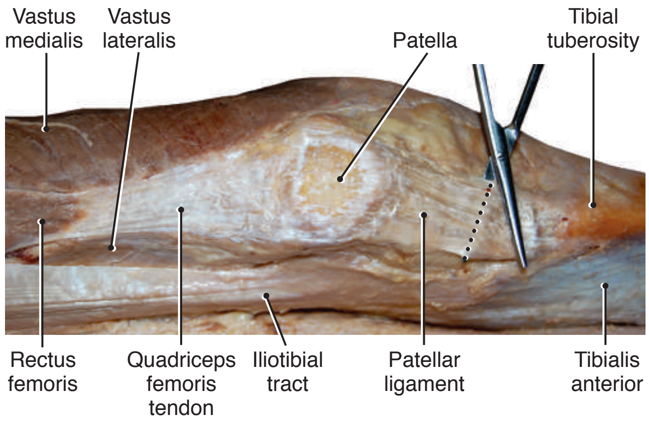
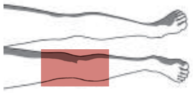

Vastus medialis
Vastus lateralis
Patella
Tibial tuberosity
Rectus femoris
Quadriceps femoris tendon
Iliotibial tract
Patellar ligament
Tibialis anterior

Fig. 18.15 Medial and lateral retinacula cut, exposing patellar ligament and quadriceps femoris tendon. Patellar ligament scissors-cut *(dotted line)* close to tibial tuberosity.



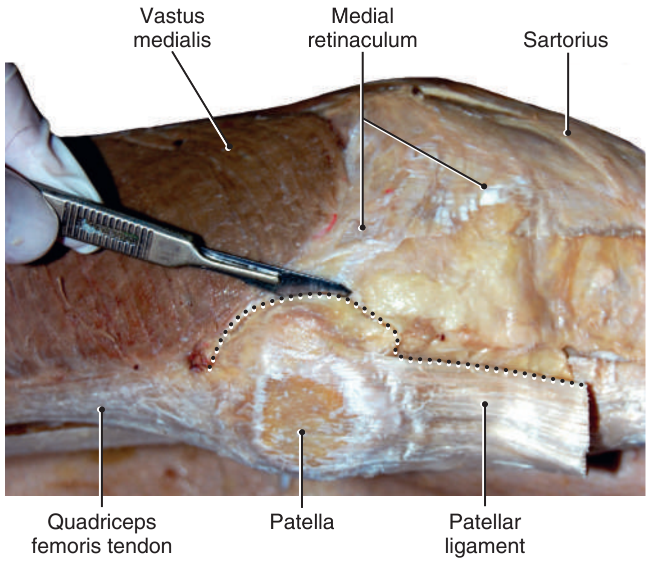
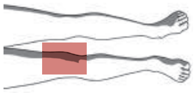

Vastus medialis
Medial retinaculum
Sartorius
Quadriceps femoris tendon
Patella
Patellar ligament

Fig. 18.16 Incision continued with scalpel lateral and medial to patella.



- With scissors, cut the patellar ligament close to the tibial tuberosity.
- Continue the incision with a scalpel lateral and medial to the patella to separate the patella from surrounding connective tissue (Fig. 18.16).
- Detach the patella from its subcutaneous prepatellar and infrapatellar bursae and fat, and reflect it superiorly, preserving its attachment to the quadriceps femoris tendon (Fig. 18.17).
- Cut the attachment of the vastus medialis muscle from the medial side of the knee, and expose this area (Fig. 18.18).
- Similarly, cut the tendon of the biceps femoris muscle from the head of the fibula (Fig. 18.19).

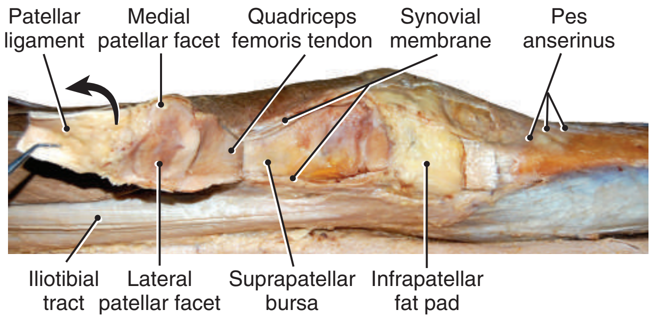
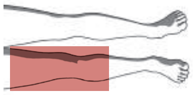

Patellar ligament
Medial patellar facet
Quadriceps femoris tendon
Synovial membrane
Pes anserinus
Iliotibial tract
Lateral patellar facet
Suprapatellar bursa
Infrapatellar fat pad

Fig. 18.17 Patella detached from bursae and fat and reflected superiorly, retaining quadriceps femoris muscle attachment.



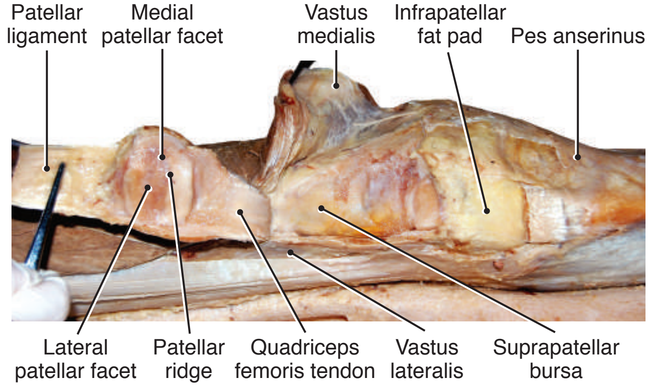
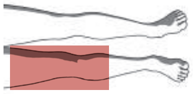

Patellar ligament
Medial patellar facet
Vastus medialis
Infrapatellar fat pad
Pes anserinus
Lateral patellar facet
Patellar ridge
Quadriceps femoris tendon
Vastus lateralis
Suprapatellar bursa

Fig. 18.18 Vastus medialis muscle reflected from medial side of knee.



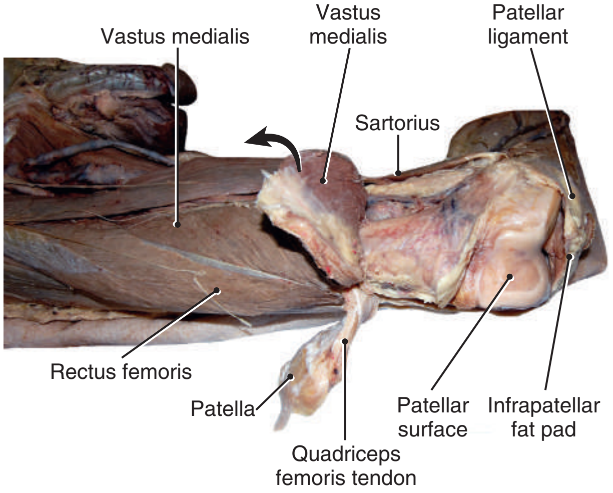
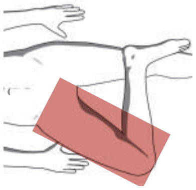

Vastus medialis
Vastus medialis
Patellar ligament
Sartorius
Rectus femoris
Patella
Patellar surface
Infrapatellar fat pad
Quadriceps femoris tendon

Fig. 18.19 Tendon of biceps femoris muscle incised from the head of fibula.



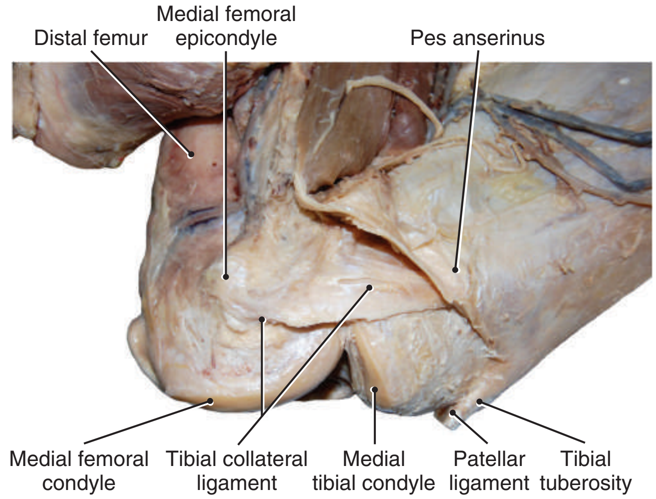
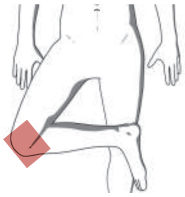

Distal femur
Medial femoral epicondyle
Pes anserinus
Medial femoral condyle
Tibial collateral ligament
Medial tibial condyle
Patellar ligament
Tibial tuberosity

Fig. 18.20 Knee flexed at joint to locate pes anserinus.



- After releasing these attachments, flex the knee joint (Fig. 18.20).
- On the medial side of the knee joint, inferior and medial to the tuberosity of the tibia, trace the common insertion of the tendons of the **sartorius, gracilis,** and **semitendinosus muscles,** the ***pes anserinus.***
- Just superior to the pes anserinus, identify the ***tibial* (medial) collateral ligament.**

ANATOMY **NOTE**

The **tibial collateral ligament** is a thick band of connective tissue that extends from the medial femoral epicondyle to the medial tibial condyle; it also attaches to the medial meniscus.

- Using scissors, cut the **tibial collateral ligament** (Fig. 18.21). Similarly, cut the **biceps femoris tendon,** and identify a thick band of connective tissue extending between the lateral femoral condyle to the head of the fibula, the ***fibular* collateral ligament.**
- Remove the infrapatellar fat pad and **infrapatellar synovial fold** to expose the **anterior cruciate ligament** and the **medial and lateral menisci** between the femur and tibia (Fig. 18.22).
- Further expose the anterior cruciate ligament. With scissors, cut the anterior cruciate ligament (Fig. 18.23).
- Expose the **posterior cruciate ligament** by flexing the knee joint farther and observe the ligament as it is stretched (Fig. 18.24 and Plate 18.3).

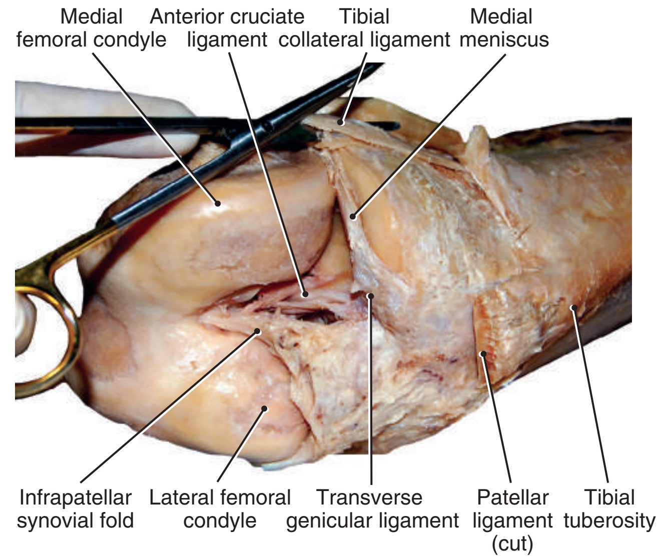
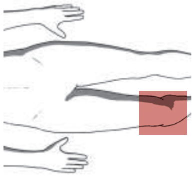

Medial femoral condyle
Anterior cruciate ligament
Tibial collateral ligament
Medial meniscus
Infrapatellar synovial fold
Lateral femoral condyle
Transverse genicular ligament
Patellar ligament (cut)
Tibial tuberosity

Fig. 18.21 View of cut tibial collateral ligament.



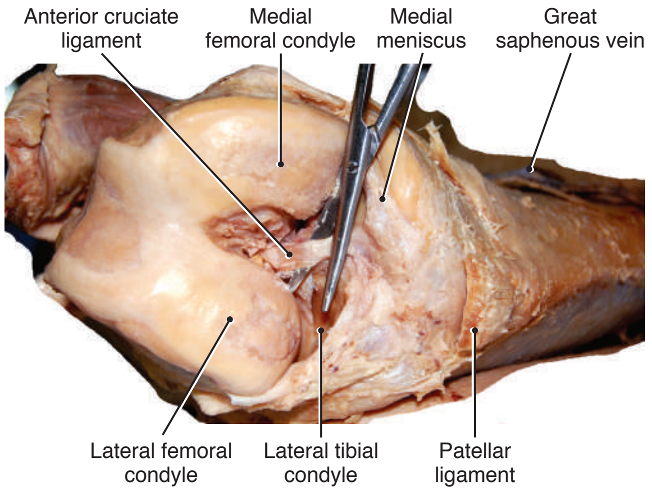
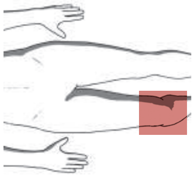

Anterior cruciate ligament
Medial femoral condyle
Medial meniscus
Great saphenous vein
Lateral femoral condyle
Lateral tibial condyle
Patellar ligament

Fig. 18.23 View of cut anterior cruciate ligament.



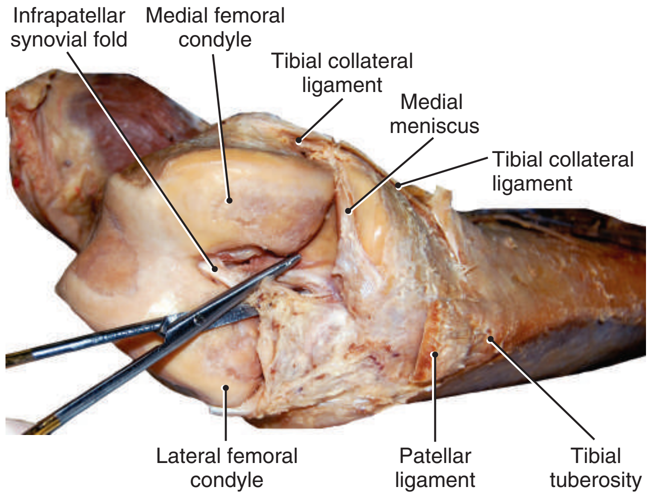
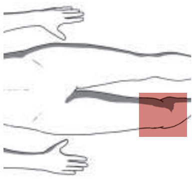

Infrapatellar synovial fold
Medial femoral condyle
Tibial collateral ligament
Medial meniscus
Tibial collateral ligament
Lateral femoral condyle
Patellar ligament
Tibial tuberosity

Fig. 18.22 Removing infrapatellar fat pad and synovial fold, exposing anterior cruciate ligament and medial/lateral menisci.



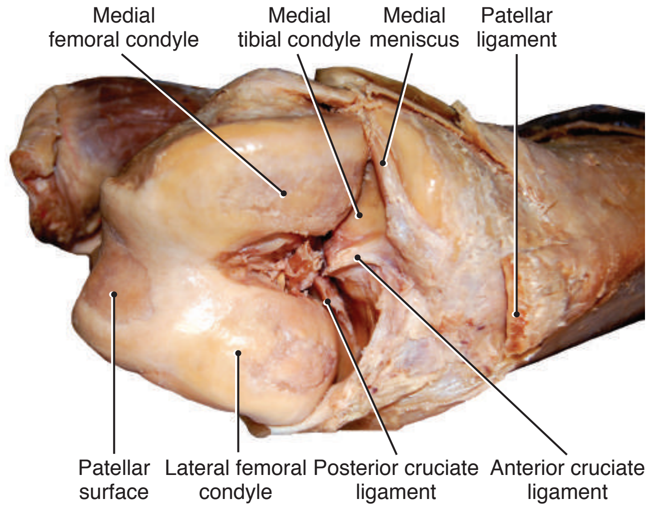
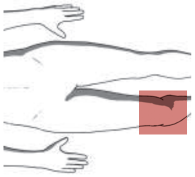
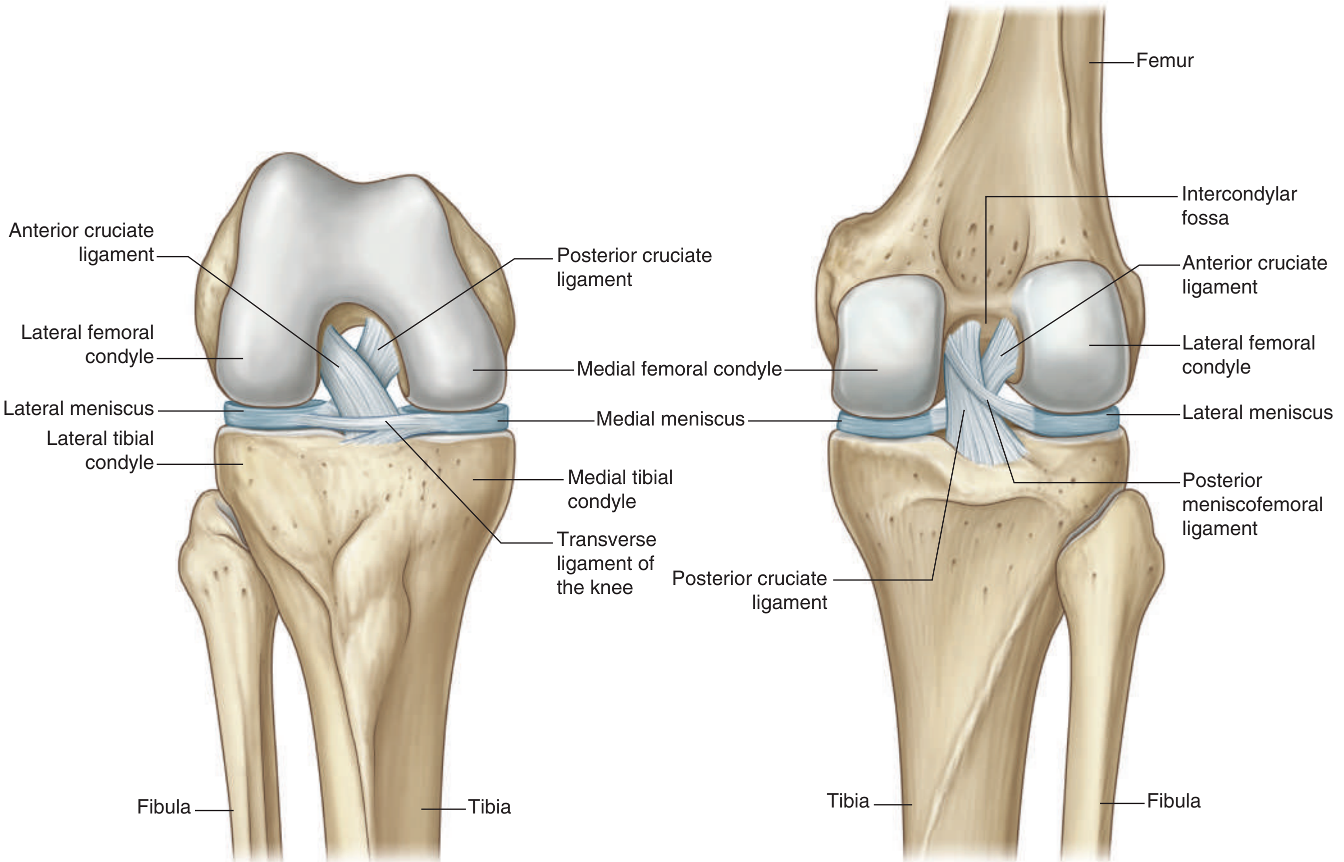

Medial femoral condyle
Medial tibial condyle
Medial meniscus
Patellar ligament
Patellar surface
Lateral femoral condyle
Posterior cruciate ligament
Anterior cruciate ligament

Fig. 18.24 In this view, appreciate the posterior cruciate ligament.




Anterior cruciate ligament
Lateral femoral condyle
Lateral meniscus
Lateral tibial condyle
Posterior cruciate ligament
Medial femoral condyle
Medial meniscus
Medial tibial condyle
Transverse ligament of the knee
Fibula
Tibia
Femur
Intercondylar fossa
Anterior cruciate ligament
Lateral femoral condyle
Lateral meniscus
Posterior meniscofemoral ligament
Posterior cruciate ligament
Tibia
Fibula

Anterior view (flexed) **Posterior view**

Plate 18.3 Anterior and posterior views of the knee.

DISSECTION TIP

If time permits, cut the posterior part of the fibrous capsule of the knee joint. Again, identify the lateral and medial menisci and the posterior cruciate ligament. Find a thick connective tissue band between the lateral meniscus and the posterior cruciate ligament, the posterior meniscofemoral ligament.

Anterior Leg

- With the cadaver supine, remove the remaining **skin** over the leg and expose the ***crural fascia*** **(deep fascia)** over the anterior compartment of the leg (Fig. 18.25).
- Make a midline longitudinal incision along the lateral side of the anterior border of the tibia, reflecting the crural fascia laterally (Fig. 18.26).
- Identify the ***superior extensor retinaculum***, a flat, broad part of the deep fascia extending from the tibia to the fibula above the **lateral malleolus** (Fig. 18.27).
- Identify the ***tibialis anterior*** muscle. Place your fingertip on its inferior border, and with blunt dissection, expose the **extensor digitorum longus muscle** (Fig. 18.28).

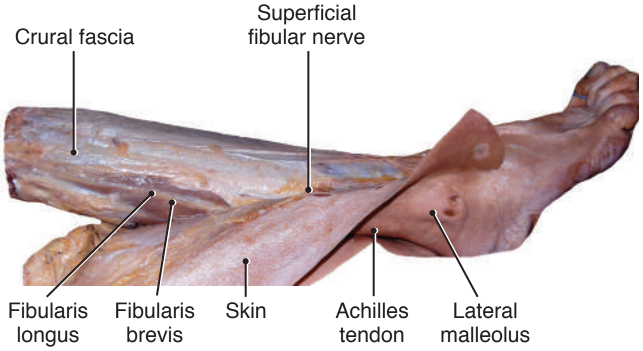
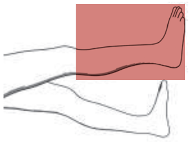

Crural fascia
Superficial fibular nerve
Fibularis longus
Fibularis brevis
Skin
Achilles tendon
Lateral malleolus

Fig. 18.25 Remaining skin over leg removed, exposing crural fascia over anterior compartment.



- Trace its tendons towards the dorsum of the foot, where they run to the lateral four digits.
- Find the **fibularis tertius muscle**, which is best seen distally lateral to the extensor digitorum longus muscle.
- Appreciate the **extensor hallucis longus** muscle in the space between the tibialis anterior and extensor digitorum longus muscles (Fig. 18.29). Note that the

tendon of the extensor hallucis longus inserts onto the base of the distal phalanx of the 1st digit.

DISSECTION **TIP**

To better visualize the deep part of the anterior compartment, place two retractors (one proximal and one distal) between the **tibialis anterior** and **fibularis longus** muscles (see Fig. 18.44).

- Identify the ***interosseous membrane*** and the area between the extensor digitorum longus and tibialis anterior muscles (Fig. 18.30).

LATERAL LEG

- Reflect the **fibularis longus** muscle inferiorly, and expose the **fibularis brevis** muscle as well as the **superficial fibular nerve** (Fig. 18.31).

ANATOMY **NOTE**

The fibularis longus is located superficially to the fibularis brevis muscle. Trace the insertion of the tendon of the fibularis brevis onto the tuberosity of the 5th metatarsal bone.

DISSECTION **TIP**

To highlight dissection landmarks, clean the fascia over the anteromedial surface of the tibia and expose the periosteum (Fig. 18.32).

ANKLE

- Using a scalpel, make a shallow, circumferential incision on the dorsum of the foot (Fig. 18.33).

DISSECTION **TIP**

The skin of the dorsum of the foot is thin; therefore the incision must be shallow. Do not spend too much time exposing the entire dorsal venous arch.

- Reflect the skin over the dorsum of the foot, and expose the tendons of the **extensor hallucis** and **extensor digitorum** muscles.
- Identify and expose the **dorsal venous arch**, then trace the small saphenous vein at the lateral aspect of the

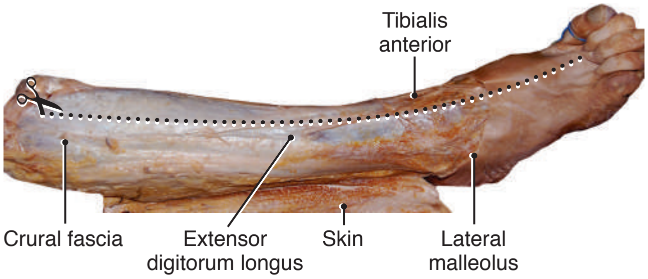
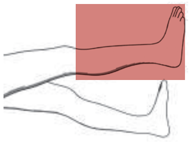

Tibialis anterior
Crural fascia
Extensor digitorum longus
Skin
Lateral malleolus

Fig. 18.26 *Dotted line* shows midline longitudinal incision along lateral side of anterior border of the tibia.



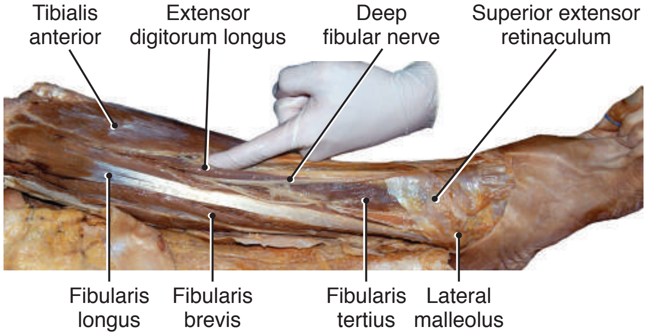
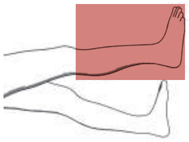

Tibialis anterior
Extensor digitorum longus
Deep fibular nerve
Superior extensor retinaculum
Fibularis longus
Fibularis brevis
Fibularis tertius
Lateral malleolus

Fig. 18.28 Extensor digitorum longus tendons on dorsum of foot toward lateral four digits.



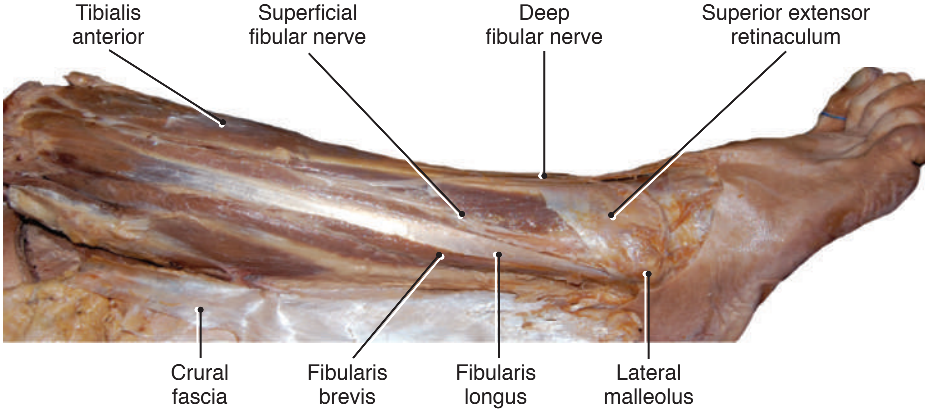
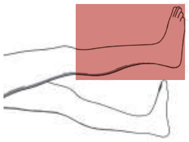

Tibialis anterior
Superficial fibular nerve
Deep fibular nerve
Superior extensor retinaculum
Crural fascia
Fibularis brevis
Fibularis longus
Lateral malleolus

Fig. 18.27 In this view, appreciate the superior extensor retinaculum.



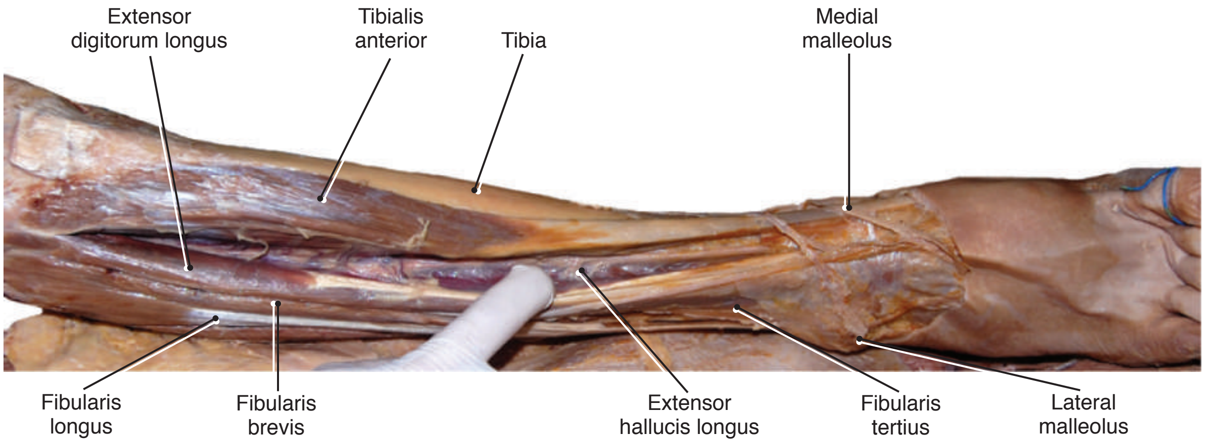
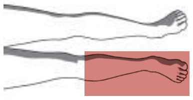

Extensor digitorum longus
Tibialis anterior
Tibia
Medial malleolus
Fibularis longus
Fibularis brevis
Extensor hallucis longus
Fibularis tertius
Lateral malleolus

Fig. 18.29 View highlighting fibularis tertius, longus, and brevis muscles; anterior intermuscular septum; and extensor hallucis longus muscle.



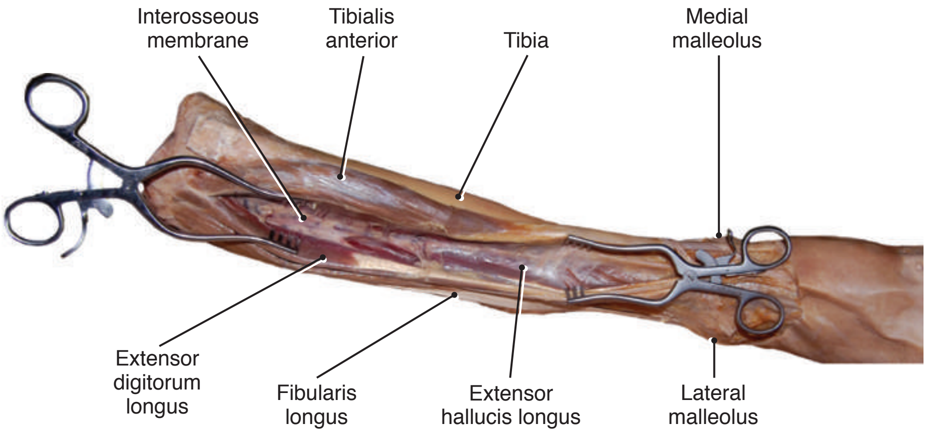
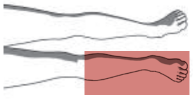

Interosseous membrane
Tibialis anterior
Tibia
Medial malleolus
Extensor digitorum longus
Fibularis longus
Extensor hallucis longus
Lateral malleolus

Fig. 18.30 Retractors placed between the tibialis anterior and fibularis longus muscles, highlighting the deep part of the anterior compartment.



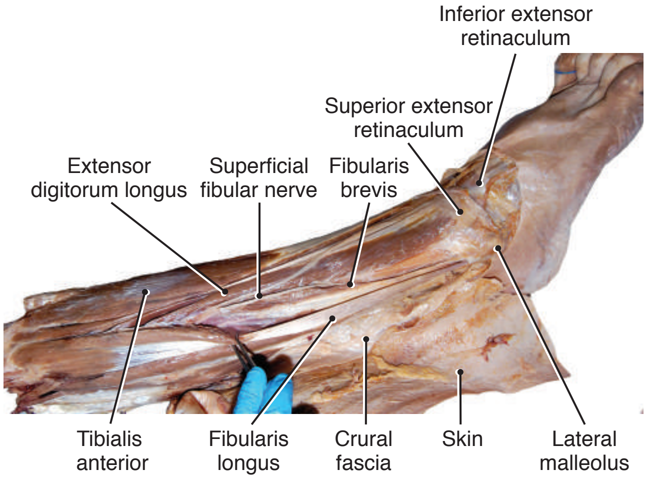
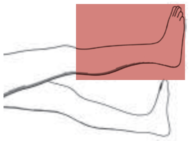

Inferior extensor retinaculum
Superior extensor retinaculum
Extensor digitorum longus
Superficial fibular nerve
Fibularis brevis
Tibialis anterior
Fibularis longus
Crural fascia
Skin
Lateral malleolus

Fig. 18.31 Fibularis longus muscle reflected inferiorly, exposing fibularis brevis muscle as well as superficial fibular nerve.



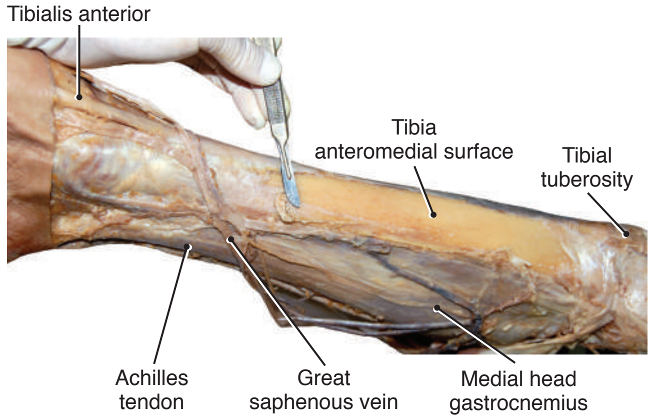
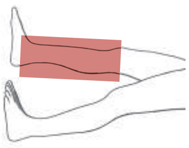

Tibialis anterior
Tibia anteromedial surface
Tibial tuberosity
Achilles tendon
Great saphenous vein
Medial head gastrocnemius

Fig. 18.32 Cleaning fascia over anteromedial tibial surface, exposing periosteum.



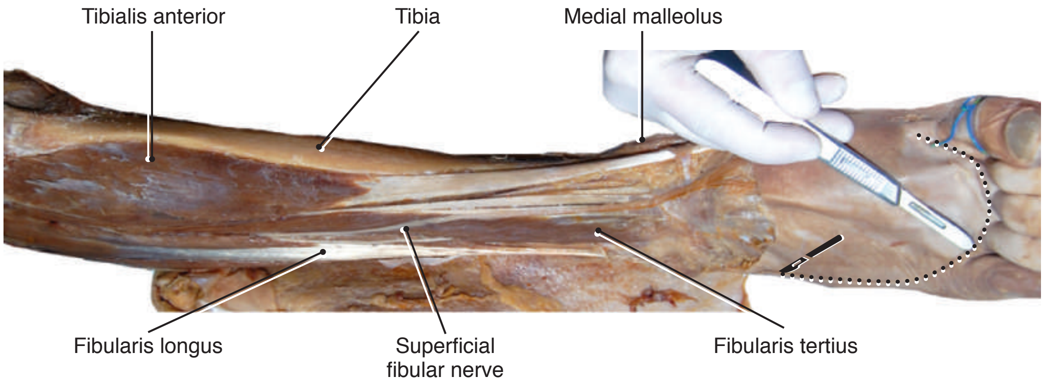
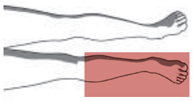

Tibialis anterior
Tibia
Medial malleolus
Fibularis longus
Superficial fibular nerve
Fibularis tertius

Fig. 18.33 Shallow circumferential incision *(dotted line)* on dorsum of foot.



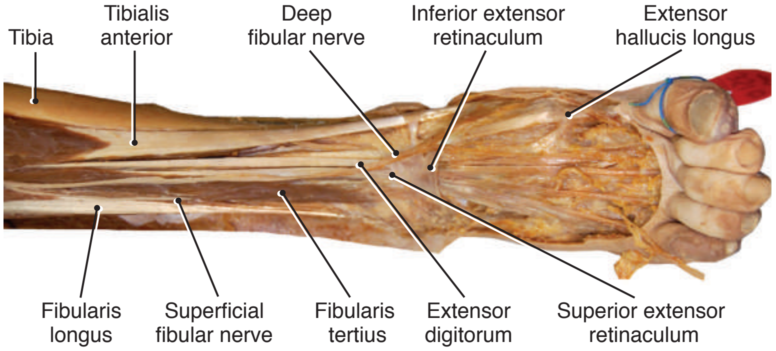
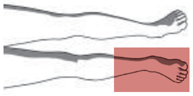

Tibia
Tibialis anterior
Deep fibular nerve
Inferior extensor retinaculum
Extensor hallucis longus
Fibularis longus
Superficial fibular nerve
Fibularis tertius
Extensor digitorum
Superior extensor retinaculum

Fig. 18.34 Appreciate superior and inferior parts of extensor retinaculum.



arch and the great saphenous vein at the medial portion of the dorsal venous arch traveling superiorly, anterior to the medial malleolus.

- Identify the extensor retinaculum, divided into the superior and inferior parts.

ANATOMY **NOTE**

The superior extensor retinaculum extends from the tibia to the fibula above the lateral malleolus as a broad, flat part of the deep fascia (Fig. 18.34).

- The inferior extensor retinaculum is a Y-shaped band of deep fascia forming a passage for the tendons of the extensor digitorum longus and fibularis tertius muscles. The inferior extensor retinaculum attaches to the *medial malleolus* (upper part) and to the *plantar aponeurosis* (lower band) (see Figs. 18.34 and 18.35).
- Cut the superior and inferior portions of the extensor retinaculum over the tendons of the extensor digitorum muscle (Fig. 18.36).
- Free the tendons of the extensor digitorum, extensor hallucis longus, tibialis anterior, and fibularis tertius

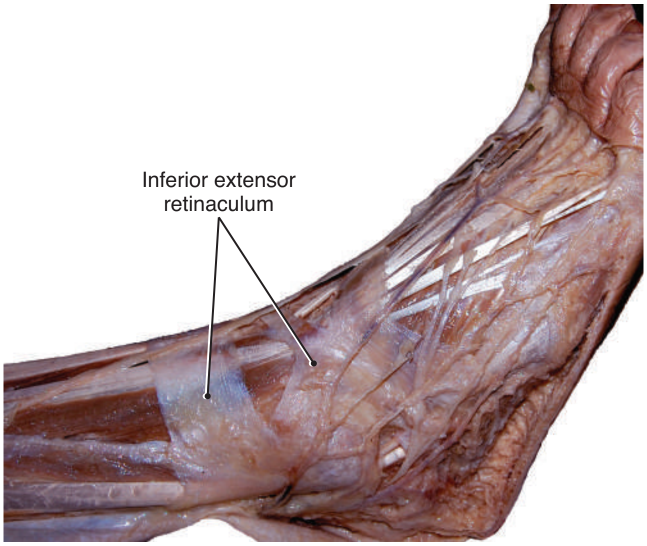
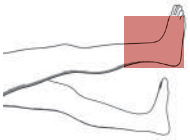
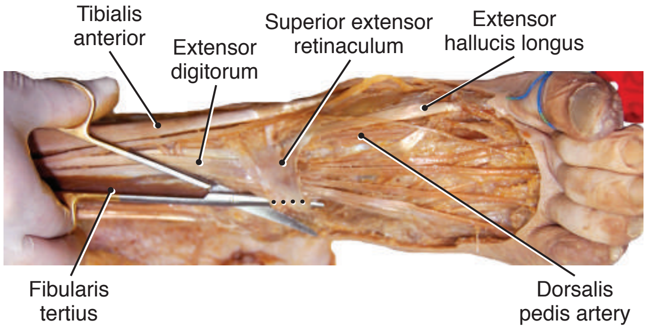

Inferior extensor retinaculum

Fig. 18.35 Note the inferior extensor retinaculum as a Y-shaped band of deep fascia forming a passage for the tendons of the extensor digitorum longus and fibularis tertius muscles.




Tibialis anterior
Extensor digitorum
Superior extensor retinaculum
Extensor hallucis longus
Fibularis tertius
Dorsalis pedis artery

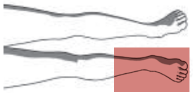
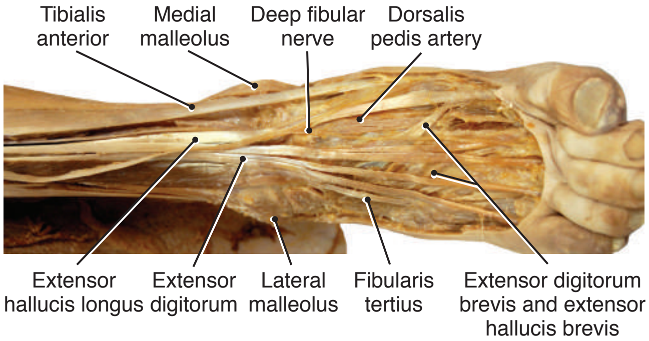


Fig. 18.36 Superior part of extensor retinaculum cut over tendons of extensor digitorum muscle.


Tibialis anterior
Medial malleolus
Deep fibular nerve
Dorsalis pedis artery
Extensor hallucis longus
Extensor digitorum
Lateral malleolus
Fibularis tertius
Extensor digitorum brevis and extensor hallucis brevis

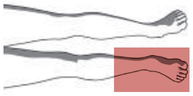


Fig. 18.37 Tendons of extensor digitorum, extensor hallucis longus, tibialis anterior, and fibularis tertius separated from underlying bursae and soft tissue.

muscles from the underlying bursae and soft tissues, toward their insertions (Fig. 18.37).

- **Identify the extensor digitorum brevis and its medial part, the extensor hallucis brevis, inserting onto the base of the proximal phalanx of the first digit.**
- **Follow the anterior tibial artery to the level of the ankle joint between the extensor halluces and extensor digitorum longus muscles, where the anterior tibial artery becomes the dorsalis pedis artery (see Fig. 18.37 and Plate 18.4).**

DISSECTION TIP

The dorsalis pedis artery is absent in approximately 20% of the population.

DISSECTION TIP

If time permits, continue the dissection as follows:

- Trace out the tendon of the extensor hallucis longus muscle to the distal phalanx of the 1st digit.
- Compare the extensor hallucis longus with the extensor digitorum longus muscle inserting onto the middle and distal phalanges.
- Follow the terminal branches of the dorsalis pedis artery: deep plantar branch and 1st metatarsal branch.

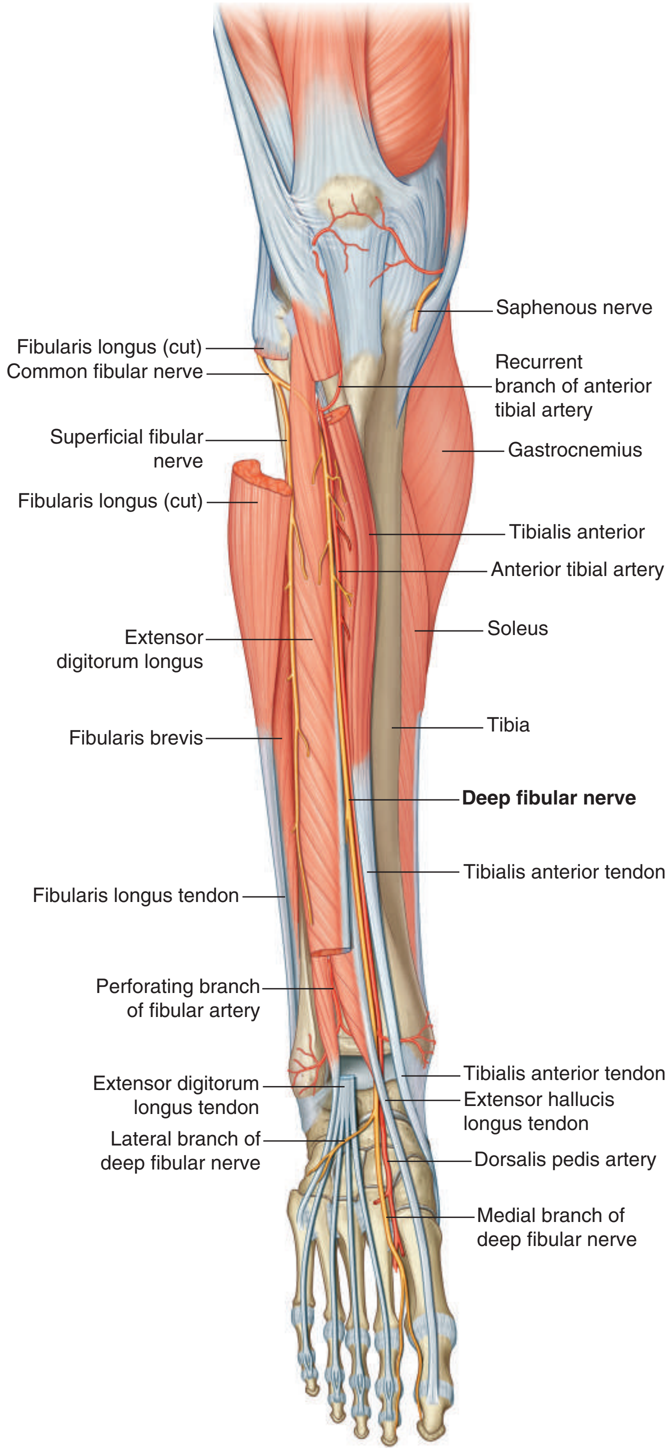

Saphenous nerve
Fibularis longus (cut)
Common fibular nerve
Recurrent branch of anterior tibial artery
Superficial fibular nerve
Gastrocnemius
Fibularis longus (cut)
Tibialis anterior
Anterior tibial artery
Extensor digitorum longus
Soleus
Fibularis brevis
Tibia
Deep fibular nerve
Tibialis anterior tendon
Fibularis longus tendon
Perforating branch of fibular artery
Tibialis anterior tendon
Extensor digitorum longus tendon
Extensor hallucis longus tendon
Lateral branch of deep fibular nerve
Dorsalis pedis artery
Medial branch of deep fibular nerve

Plate 18.4 Arteries and nerves of the anterolateral leg.

- **Continue the dissection along the lateral aspect of ankle joint at the level of the *lateral malleolus* (see Fig. 18.38).**
- **Expose the tendons of the fibularis brevis and fibularis longus muscles (Fig. 18.38).**
- **Clean the fat around the lateral malleolus, and expose the structures of this region (see Fig. 18.38).**

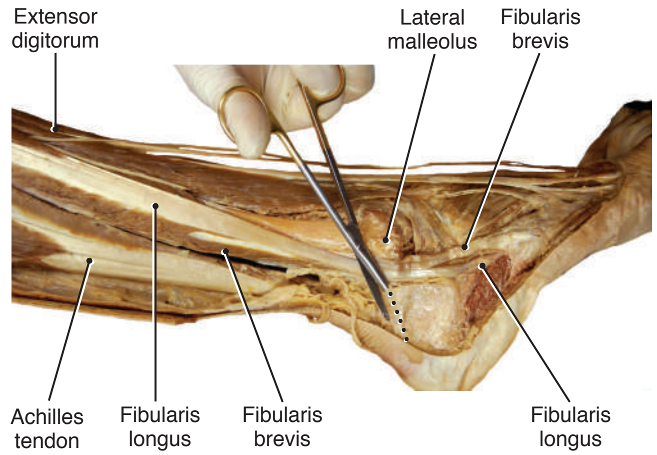
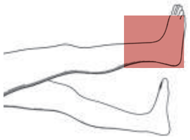

Extensor digitorum
Lateral malleolus
Fibularis brevis
Achilles tendon
Fibularis longus
Fibularis brevis
Fibularis longus

Fig. 18.38 View of exposed tendons of fibularis brevis and fibularis longus muscles.



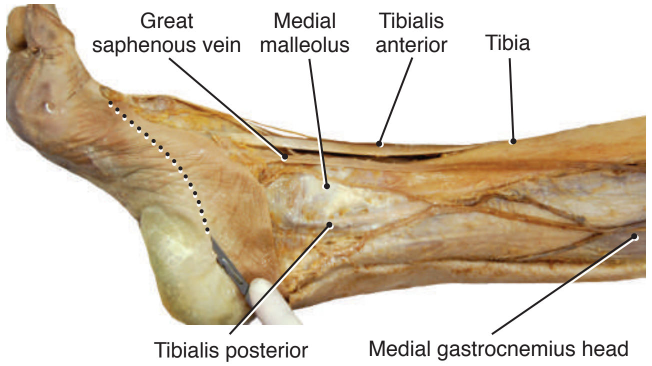
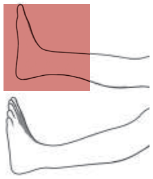

Great saphenous vein
Medial malleolus
Tibialis anterior
Tibia
Tibialis posterior
Medial gastrocnemius head

Fig. 18.39 View of skin incision over medial malleolus.



- Cut the skin over the **medial malleolus** and expose the **crural fascia** (Fig. 18.39).
- With scissors, cut the **crural fascia** over the medial malleolus (Fig. 18.40).
- Identify the **flexor retinaculum** attaching between the medial malleolus and the medial surface of the calcaneus. This flexor retinaculum forms the **tarsal tunnel.**
- Cut the **flexor retinaculum,** and expose the **tibial nerve,** the **posterior tibial artery,** the **tibialis posterior muscle,** the **flexor digitorum longus muscle,** and the **Achilles tendon.**
- If time permits, expose the tendon of the tibialis posterior muscle to the navicular bone, one of its many insertion sites.

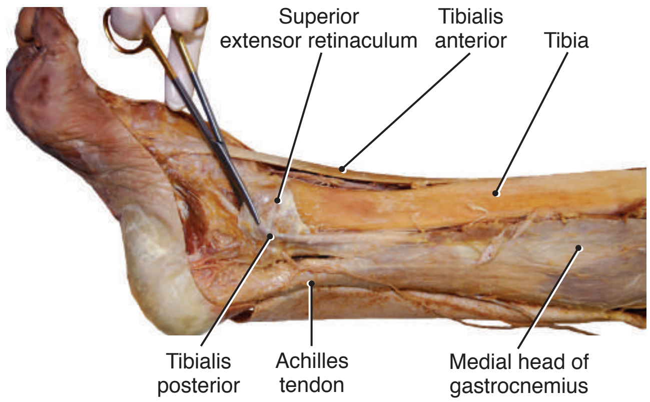
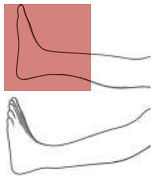

Superior extensor retinaculum
Tibialis anterior
Tibia
Tibialis posterior
Achilles tendon
Medial head of gastrocnemius

Fig. 18.40 Crural (deep) fascia cut over medial malleolus.



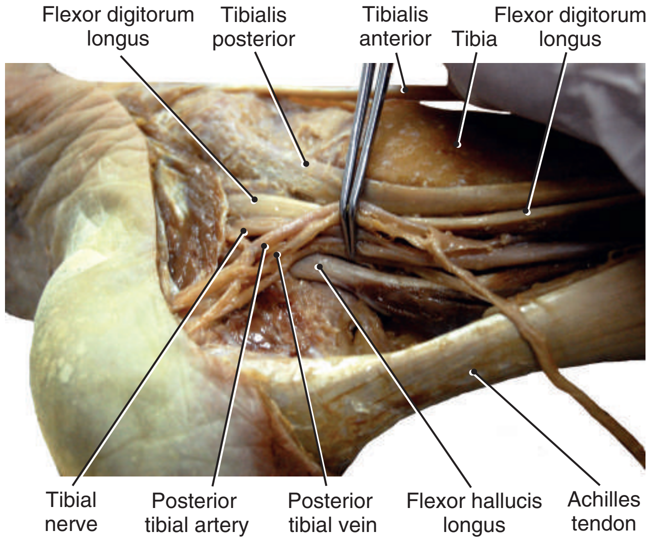
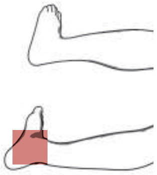

Flexor digitorum longus
Tibialis posterior
Tibialis anterior
Tibia
Flexor digitorum longus
Tibial nerve
Posterior tibial artery
Posterior tibial vein
Flexor hallucis longus
Achilles tendon

Fig. 18.41 Note the relationship of structures passing through the tarsal tunnel.



ANATOMY **NOTE**

The relationship of these structures to the medial malleolus is important for their recognition (Figs. 18.41 and 18.42). From anterior to posterior, the structures are arranged as follows (Plate 18.5):

- Tendon of tibialis posterior muscle
- Tendon of flexor digitorum longus muscle
- Posterior tibial artery and vein
- Tibial nerve
- Flexor hallucis longus muscle

To remember the relationship of these structures at the medial malleolus, use one of the following mnemonics:
Tom, Dick, And Harry
Tom Drives A Very Nervous Harry
Tom, Dick, and A Very Nervous Harry

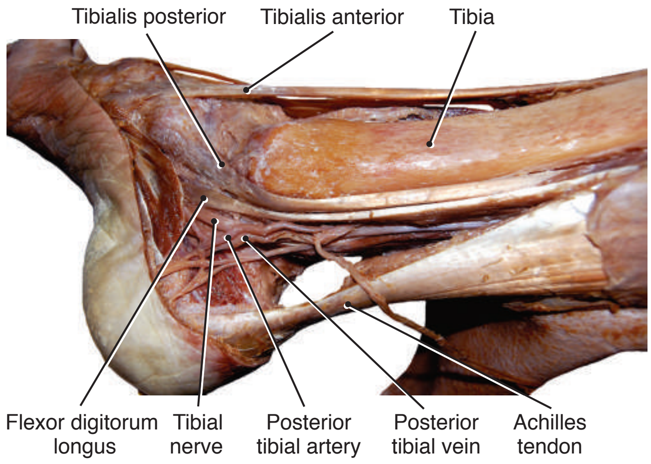
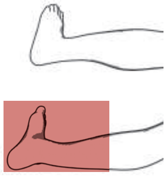

Tibialis posterior
Tibialis anterior
Tibia
Flexor digitorum longus
Tibial nerve
Posterior tibial artery
Posterior tibial vein
Achilles tendon

Fig. 18.42 Appreciate the order of tendons, vessels, and nerves as they pass by the medial malleolus.



OPTIONAL DISSECTION OF LIGAMENTS OF FOOT AND ANKLE

- **Identify the lateral ligament of the ankle, formed by the anterior and posterior talofibular ligaments and the calcaneofibular ligament.**
- **Identify the interosseous talocalcaneal ligament on the lateral side of the foot (Fig. 18.43).**
- **Expose and cut the tendons of the tibialis anterior and tibialis posterior muscles at their insertion points.**
- **Just underneath, identify the deltoid ligament (medial side of ankle), formed by the anterior tibiotalar, tibionavicular, tibiocalcaneal, and posterior tibiotalar parts (Fig. 18.44).**
- **Look lateral and underneath the tendon of the tibialis posterior muscle for the plantar calcaneonavicular *(spring)* ligament connecting the calcaneus to the navicular bones.**
- **Lateral to the calcaneonavicular ligament, expose the long and short plantar ligaments (Fig. 18.45).**

  See also Chapter 19.

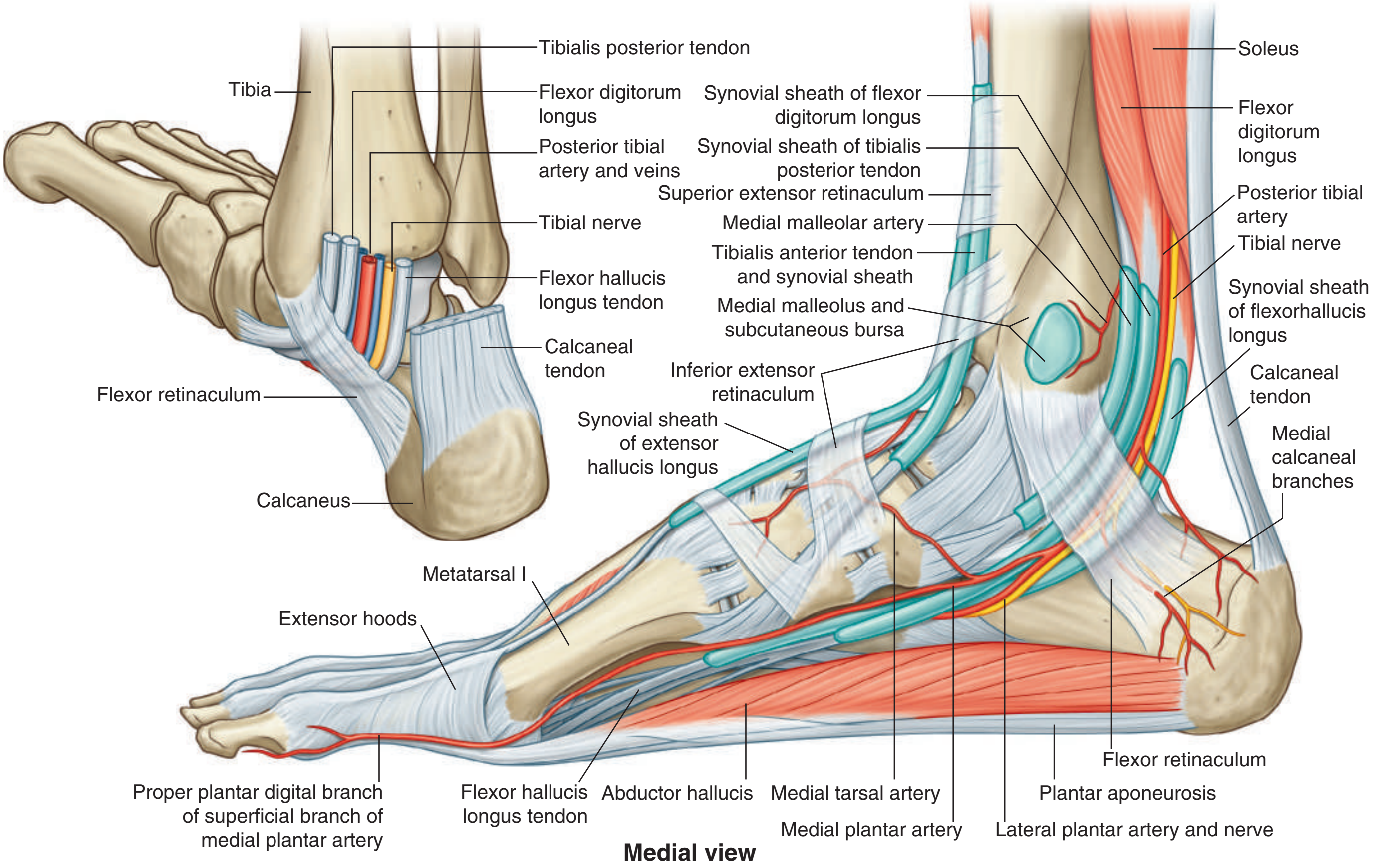

Tibialis posterior tendon
Tibia
Flexor digitorum longus
Posterior tibial artery and veins
Tibial nerve
Flexor hallucis longus tendon
Calcaneal tendon
Flexor retinaculum
Calcaneus
Synovial sheath of flexor digitorum longus
Synovial sheath of tibialis posterior tendon
Superior extensor retinaculum
Medial malleolar artery
Tibialis anterior tendon and synovial sheath
Medial malleolus and subcutaneous bursa
Inferior extensor retinaculum
Synovial sheath of extensor hallucis longus
Soleus
Flexor digitorum longus
Posterior tibial artery
Tibial nerve
Synovial sheath of flexorhallucis longus
Calcaneal tendon
Medial calcaneal branches
Metatarsal I
Extensor hoods
Proper plantar digital branch of superficial branch of medial plantar artery
Flexor hallucis longus tendon
Abductor hallucis
Medial tarsal artery
Medial plantar artery
Flexor retinaculum
Plantar aponeurosis
Lateral plantar artery and nerve
Medial view

Plate 18.5 Structures of the medial foot and ankle.

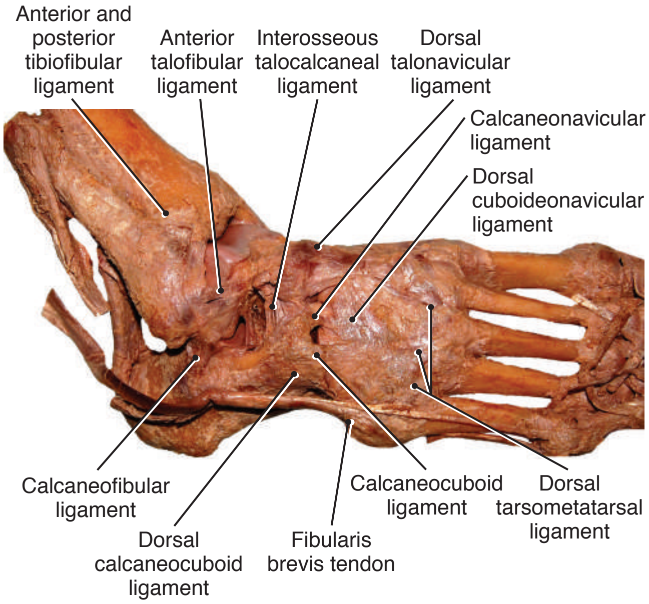
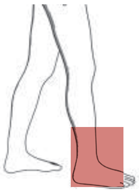

Anterior and posterior tibiofibular ligament
Anterior talofibular ligament
Interosseous talocalcaneal ligament
Dorsal talonavicular ligament
Calcaneonavicular ligament
Dorsal cuboideonavicular ligament
Calcaneofibular ligament
Dorsal calcaneocuboid ligament
Fibularis brevis tendon
Calcaneocuboid ligament
Dorsal tarsometatarsal ligament

Fig. 18.43 Optional dissection: lateral view of ankle, highlighting ligaments.



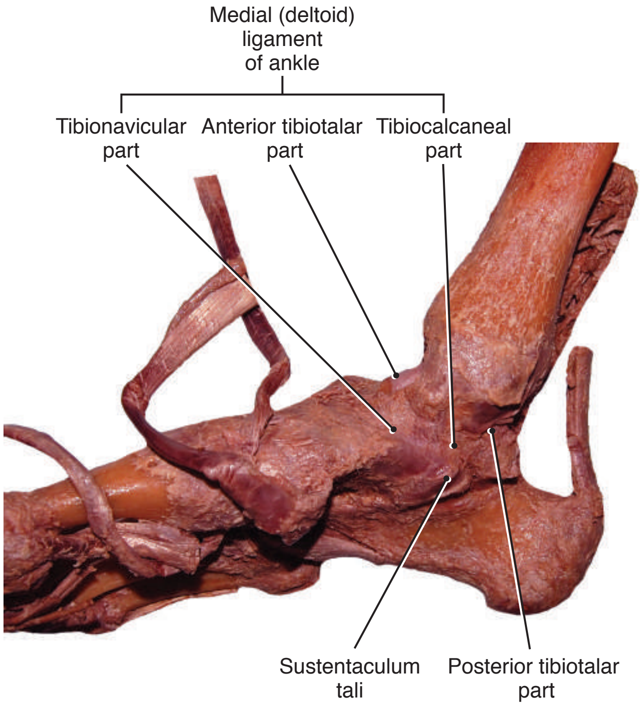
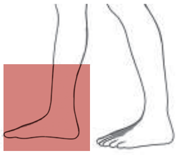

Medial (deltoid) ligament of ankle
Tibionavicular part
Anterior tibiotalar part
Tibiocalcaneal part
Sustentaculum tali
Posterior tibiotalar part

Fig. 18.44 Optional dissection: medial view of ankle, demonstrating deltoid (medial) ligament.



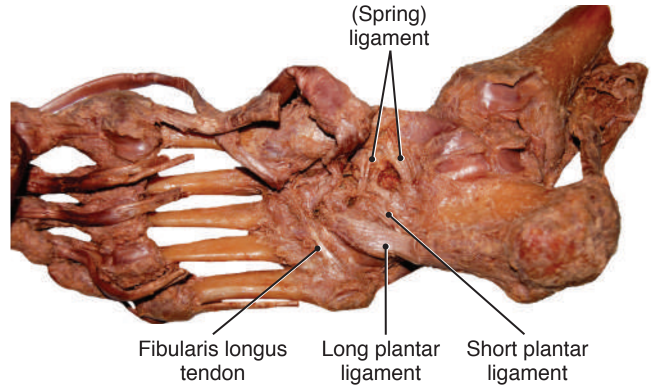

(Spring) ligament
Fibularis longus tendon
Long plantar ligament
Short plantar ligament

Fig. 18.45 Optional dissection: plantar view of foot, highlighting plantar calcaneonavicular (spring) ligament and long and short plantar ligaments.

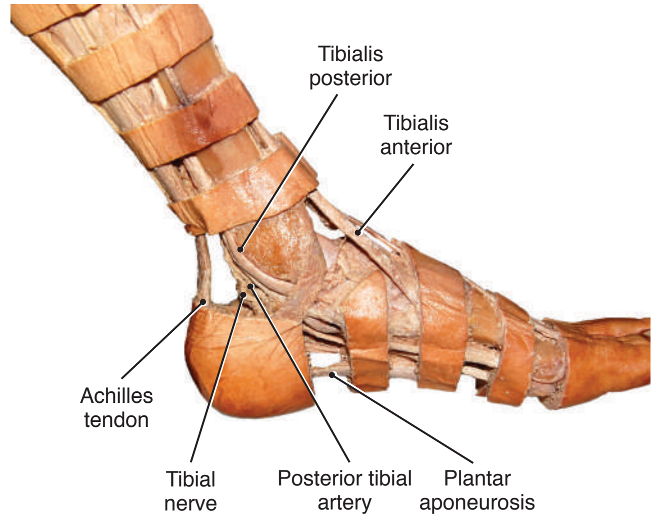
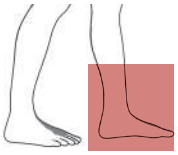

Tibialis posterior
Tibialis anterior
Achilles tendon
Tibial nerve
Posterior tibial artery
Plantar aponeurosis

Fig. 18.46 Special dissection: lateral view, demonstrating depth from skin to differing layers of foot, ankle, and leg, from superficial to deep.



DISSECTION **TIP**

The long plantar ligament crosses over the tendon of the fibularis longus muscle. The short plantar (plantar calcaneocuboid) ligament attaches to the cuboid bone. Sometimes, the long plantar ligament may be confused with the spring ligament attached to the navicular bone (see Fig. 18.45).

CREATIVE DISSECTION

- In this dissection, we left strips of skin intact. We dissected the intervals in between to appreciate the depth from skin to the different layers of the foot, ankle, and leg from superficial to deep (Figs. 18.46 to 18.48).

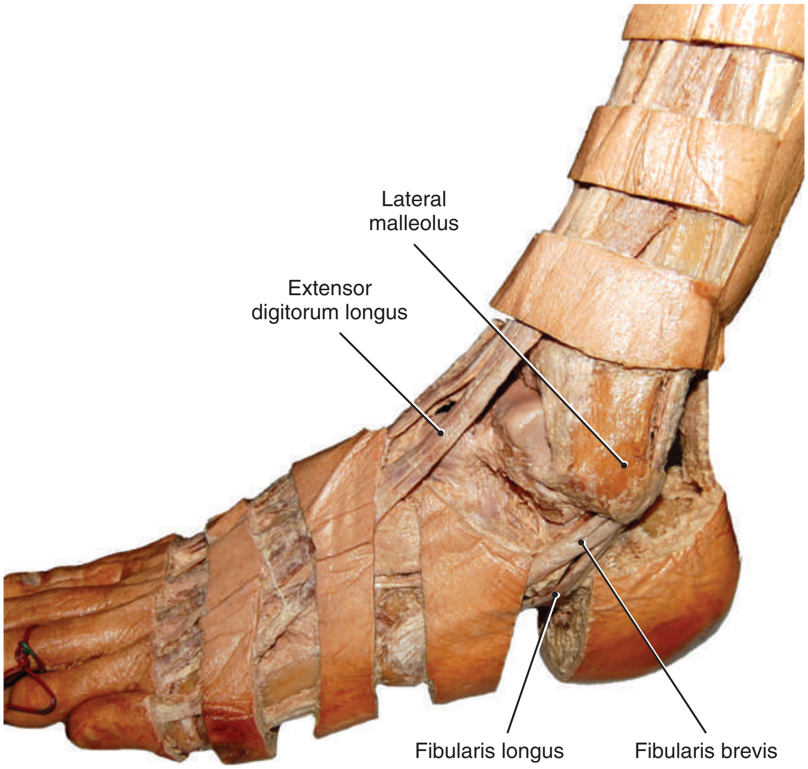
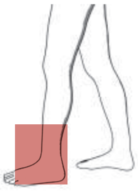

Lateral malleolus
Extensor digitorum longus
Fibularis longus
Fibularis brevis

Fig. 18.47 Special dissection: medial view; appreciate depth from skin (superficial to deep) to different layers of the foot, ankle, and leg.



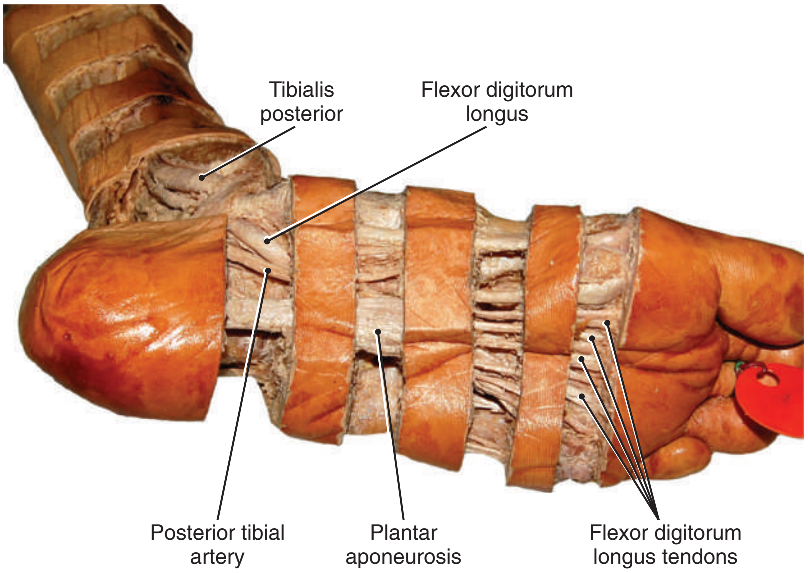

Tibialis posterior
Flexor digitorum longus
Posterior tibial artery
Plantar aponeurosis
Flexor digitorum longus tendons

Fig. 18.48 Special dissection: plantar view, highlighting differing layers of the foot and ankle, from superficial to deep.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Common fibular
  - ☐ Superficial fibular
  - ☐ Lateral sural cutaneous
- ☐ Sural communicating (normally formed from tibial and common fibular, but can form independently)
- ☐ Deep fibular
- ☐ Tibial nerve
  - ☐ Medial sural cutaneous
- ☐ Sural (normally formed from tibial and common fibular, but can form independently)

ARTERIES

- ☐ Popliteal
- ☐ Anterior tibial
- ☐ Posterior tibial
- ☐ Circumflex fibular
- ☐ Fibular

VEINS

- ☐ *Superficial*
  - ☐ Great (long) saphenous
  - ☐ Small (lesser) saphenous
- ☐ Deep
  - ☐ Popliteal
  - ☐ Posterior tibial
  - ☐ Fibular
  - ☐ Anterior tibial
  - ☐ Sural

MUSCLES

- ☐ *Anterior compartment*
- ☐ Tibialis anterior
- ☐ Extensor hallucis longus
- ☐ Extensor digitorum longus
- ☐ Fibularis tertius
- ☐ *Posterior compartment*
- ☐ Superficial
  - ☐ Gastrocnemius
  - ☐ Soleus
  - ☐ Plantaris
- ☐ Deep
  - ☐ Popliteus
  - ☐ Flexor hallucis longus
  - ☐ Flexor digitorum longus
  - ☐ Tibialis posterior
- ☐ *Lateral compartment*
- ☐ Fibularis longus
- ☐ Fibularis brevis

CONNECTIVE TISSUE

- ☐ Anterior intermuscular septum
- ☐ Transverse intermuscular septum
- ☐ Posterior intermuscular septum
- ☐ Interosseous membrane
- ☐ Superior extensor retinaculum

LIGAMENTS

- ☐ *Lateral ankle complex*
  - ☐ Anterior talofibular ligament
  - ☐ Calcaneofibular ligament
  - ☐ Posterior talofibular ligament
- ☐ *Medial ankle complex*
  - ☐ Deltoid
    - ☐ Anterior tibiotalar part
    - ☐ Tibionavicular part
    - ☐ Tibiocalcaneal part
    - ☐ Posterior tibiotalar part
    - ☐ Long
    - ☐ Short
    - ☐ Spring

BONES

- ☐ Fibula
- ☐ Tibia

CHAPTER 19 FOOT

ATLAS REFERENCES

Netter: 516–528
McMinn: 344–354
Gray's Atlas: 350–363

BEFORE YOU BEGIN

Identify and palpate the **calcaneus**, the **lateral longitudinal arch**, and the five **metatarsal heads** (Fig. 19.1).

SKIN AND SUBCUTANEOUS TISSUE

- **Make a longitudinal incision starting from the lateral side of the calcaneus and following the lateral side of the lateral longitudinal arch, terminating at the 1st metatarsal head (Fig. 19.2).**

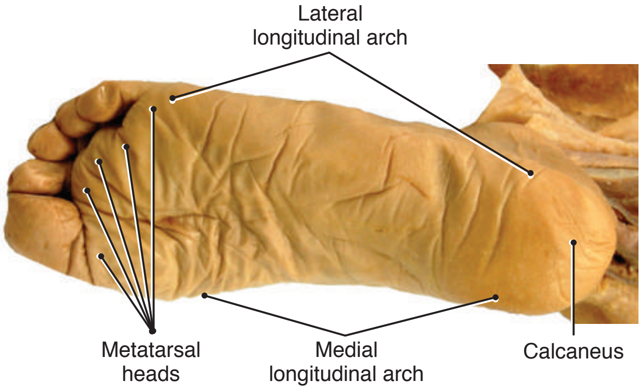
DISSECTION **TIP**

You also could begin the incision from the plantar surface of the 1st metatarsal head and then end at the calcaneus.

DISSECTION **TIP**

An alternate incision involves making a longitudinal cut from the calcaneus to the first digit and a second, transverse incision from the first digit to the lateral longitudinal arch, then removing the skin laterally from the foot.

- **Reflect the skin medially while maintaining its attachment to the calcaneus (Fig. 19.3). Observe the fatty,**


Lateral longitudinal arch
Metatarsal heads
Medial longitudinal arch
Calcaneus

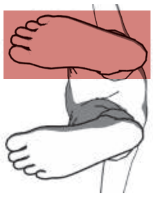


Fig. 19.1 View of the plantar surface of the foot for identifying calcaneus, lateral longitudinal arch, and five metatarsal heads.

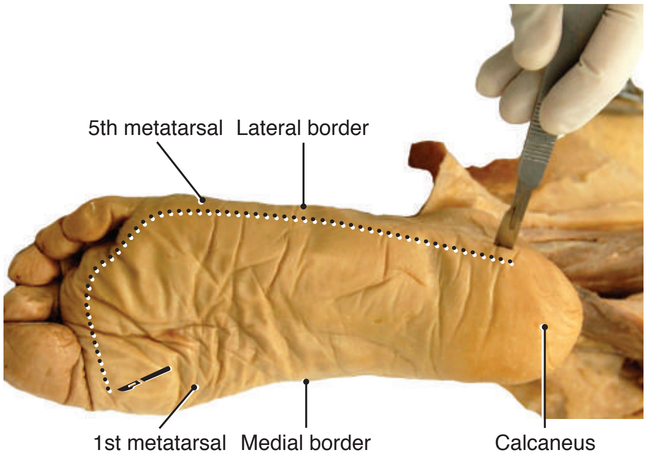
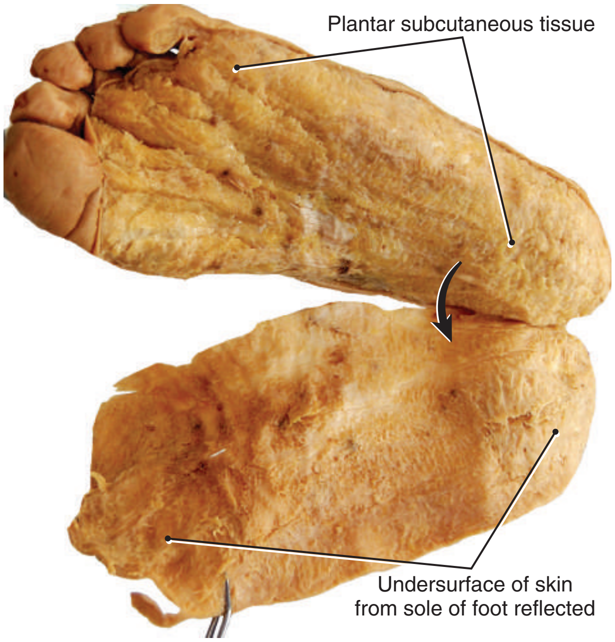

5th metatarsal
Lateral border
1st metatarsal
Medial border
Calcaneus

Fig. 19.2 Longitudinal incision starts from lateral side of calcaneus and follows lateral longitudinal arch.


Plantar subcutaneous tissue
Undersurface of skin from sole of foot reflected

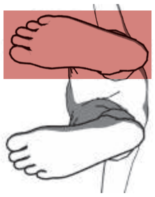


Fig. 19.3 Skin completely reflected over plantar portion of foot, maintaining attachment to calcaneus.

plantar subcutaneous tissue, and the thick layer of connective tissue, the **plantar aponeurosis.**

- With a scalpel, make an incision from the lateral side of the calcaneus, reflecting the **plantar subcutaneous tissue** over the plantar aponeurosis medially (Fig. 19.4).
- Remove the fat and expose the plantar aponeurosis with its fibrous slips to the digits.

(SUPERFICIAL) 1ST LAYER OF PLANTAR FOOT MUSCLES

ANATOMY **NOTE**

The three muscles that make up the 1st and most superficial layer of muscles of the plantar surface of the foot are abductor hallucis, flexor digitorum brevis, and abductor digiti minimi.

- On the lateral side of the foot, identify the **abductor digiti minimi** muscle and the underlying **flexor digiti minimi** muscle (Fig. 19.5).
- With a scalpel, cut the plantar aponeurosis at its junction with the flexor digiti minimi muscle, and reflect it toward the calcaneus (see Figs. 19.5 and 19.6).
- Just underneath the plantar aponeurosis, separate the **flexor digitorum brevis** muscle, which arises from the deep surface of the aponeurosis (see Fig. 19.6).
- Carefully dissect out the fibrous attachments between the plantar aponeurosis and the digits (Fig. 19.7).
- Identify and clean the **abductor hallucis** muscle located on the medial side of the foot (see Fig. 19.7).
- Lateral to the abductor hallucis muscle, clean and expose the tendons of the **flexor digitorum brevis muscle** (see Fig. 19.7).

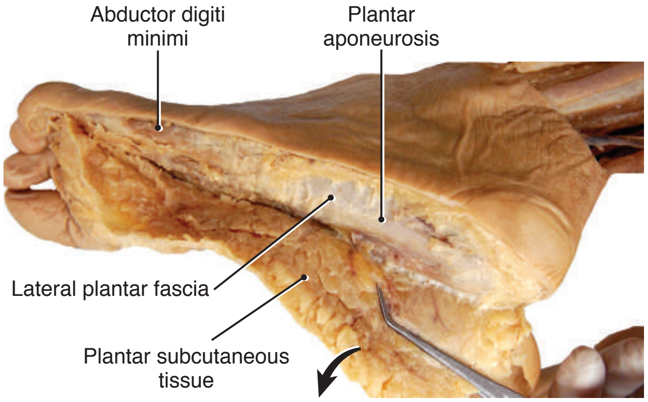

Abductor digiti minimi
Plantar aponeurosis
Lateral plantar fascia
Plantar subcutaneous tissue

Fig. 19.4 Lateral side of calcaneus incised, reflecting fat over plantar aponeurosis medially.

- Lateral **to the flexor digitorum brevis**, identify and clean the abductor digiti minimi muscle (see Fig. 19.7).
- Between the abductor hallucis and flexor digitorum brevis muscles, identify and expose the **medial plantar nerve** (see Fig. 19.7).
- Identify the digital branches of the medial plantar nerve (see Fig. 19.7).

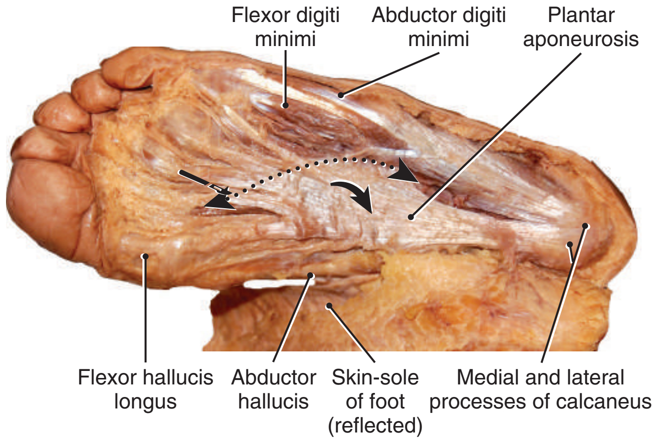

Flexor digiti minimi
Abductor digiti minimi
Plantar aponeurosis
Flexor hallucis longus
Abductor hallucis
Skin-sole of foot (reflected)
Medial and lateral processes of calcaneus

Fig. 19.5 Fat removal exposes the plantar aponeurosis and fibrous slips to the digits.

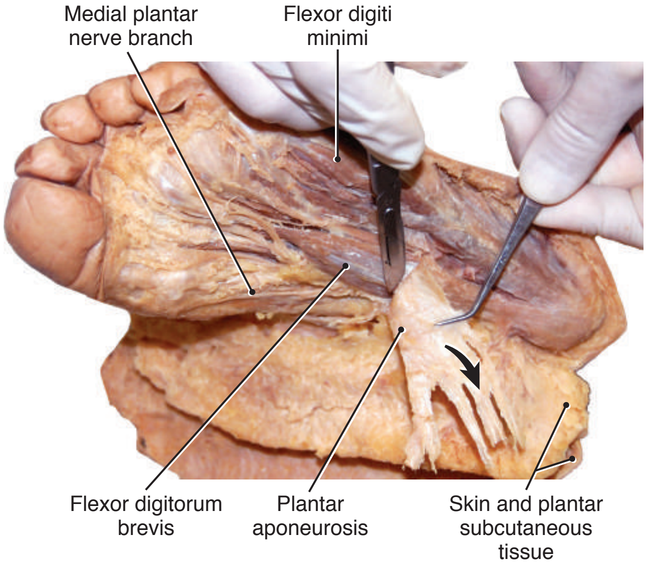

Medial plantar nerve branch
Flexor digiti minimi
Flexor digitorum brevis
Plantar aponeurosis
Skin and plantar subcutaneous tissue

Fig. 19.6 Abductor digiti minimi muscle and underlying flexor digiti minimi on lateral side of foot, with plantar aponeurosis reflected toward calcaneus, and flexor digitorum brevis muscle separated.

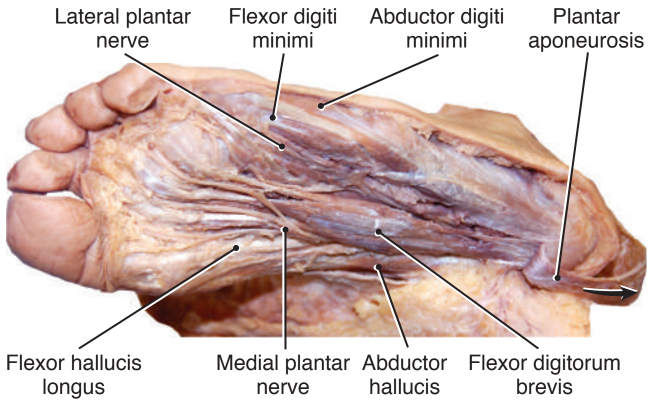

Lateral plantar nerve
Flexor digiti minimi
Abductor digiti minimi
Plantar aponeurosis
Flexor hallucis longus
Medial plantar nerve
Abductor hallucis
Flexor digitorum brevis

Fig. 19.7 Dissected view between plantar aponeurosis and digits reveals digital branches of medial plantar nerve, abductor hallucis muscle, and tendons of flexor digitorum brevis and abductor digiti minimi muscles.

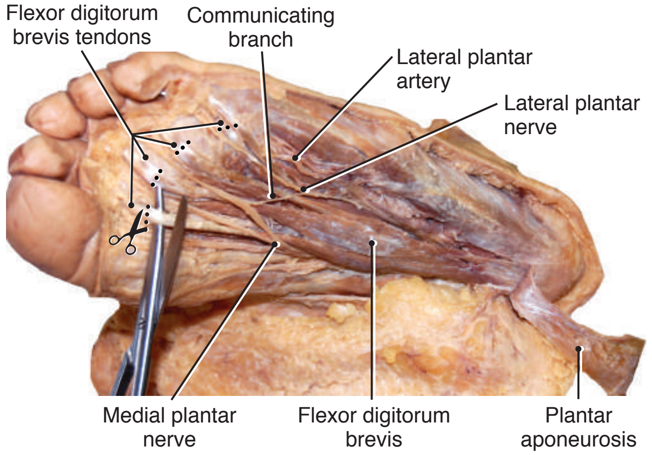

Flexor digitorum brevis tendons
Communicating branch
Lateral plantar artery
Lateral plantar nerve
Medial plantar nerve
Flexor digitorum brevis
Plantar aponeurosis

Fig. 19.8 Medial plantar nerve exposed between abductor hallucis and flexor digitorum brevis muscles, with distal parts of flexor digitorum brevis tendons incised.

2ND LAYER OF PLANTAR FOOT MUSCLES

ANATOMY **NOTE**

The muscles that make up the 2nd layer of muscles of the plantar region of the foot are flexor hallucis longus, flexor digitorum longus, lumbricals, and quadratus plantae.

- Identify the distal part of the tendons of the flexor digitorum brevis muscle, and cut them using scissors (Fig. 19.8).

DISSECTION **TIP**

Be careful not to cut the medial plantar nerve.

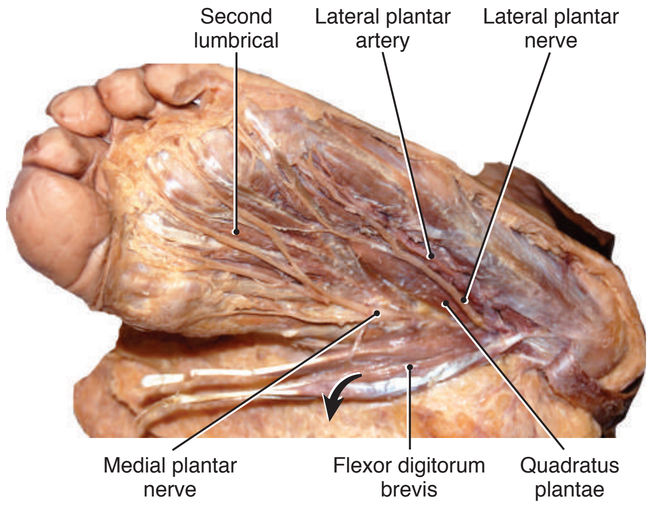

Second lumbrical
Lateral plantar artery
Lateral plantar nerve
Medial plantar nerve
Flexor digitorum brevis
Quadratus plantae

Fig. 19.9 View of lateral plantar nerve and artery underneath flexor digitorum brevis muscle.

- Reflect the tendons (with the belly of the flexor digitorum brevis) posteriorly (Fig. 19.9).
- Just underneath the flexor digitorum brevis, clean and expose the **lateral plantar nerve** and **lateral plantar artery** as they travel to the lateral side of the foot (see Fig. 19.9 and Plate 19.1).
- Identify and clean the tendon of the **flexor hallucis longus** muscle located on the medial side of the foot and inserting onto the base of the distal phalanx of the 1st digit (Fig. 19.10).
- Lateral to the flexor hallucis longus muscle, identify the tendons of the **flexor digitorum longus** muscle inserting onto the distal phalanges of the remaining four digits (see Fig. 19.10).
- Arising from the tendons of the flexor digitorum longus, identify the four **lumbrical** muscles (see Fig. 19.10).
- Lateral to the main belly of the flexor digitorum longus, identify a small muscle arising from the calcaneus and inserting onto the flexor digitorum, the **quadratus plantae muscle** (see Fig. 19.10).

3RD LAYER OF PLANTAR FOOT MUSCLES

ANATOMY **NOTE**

The muscles that occupy the 3rd layer of muscles of the plantar aspect of the foot are adductor hallucis, flexor hallucis brevis, abductor digiti minimi, and flexor digiti minimi brevis.

- With scissors, cut the tendon of the flexor digitorum longus at the posterior aspect of the foot near the calcaneus (Fig. 19.11).

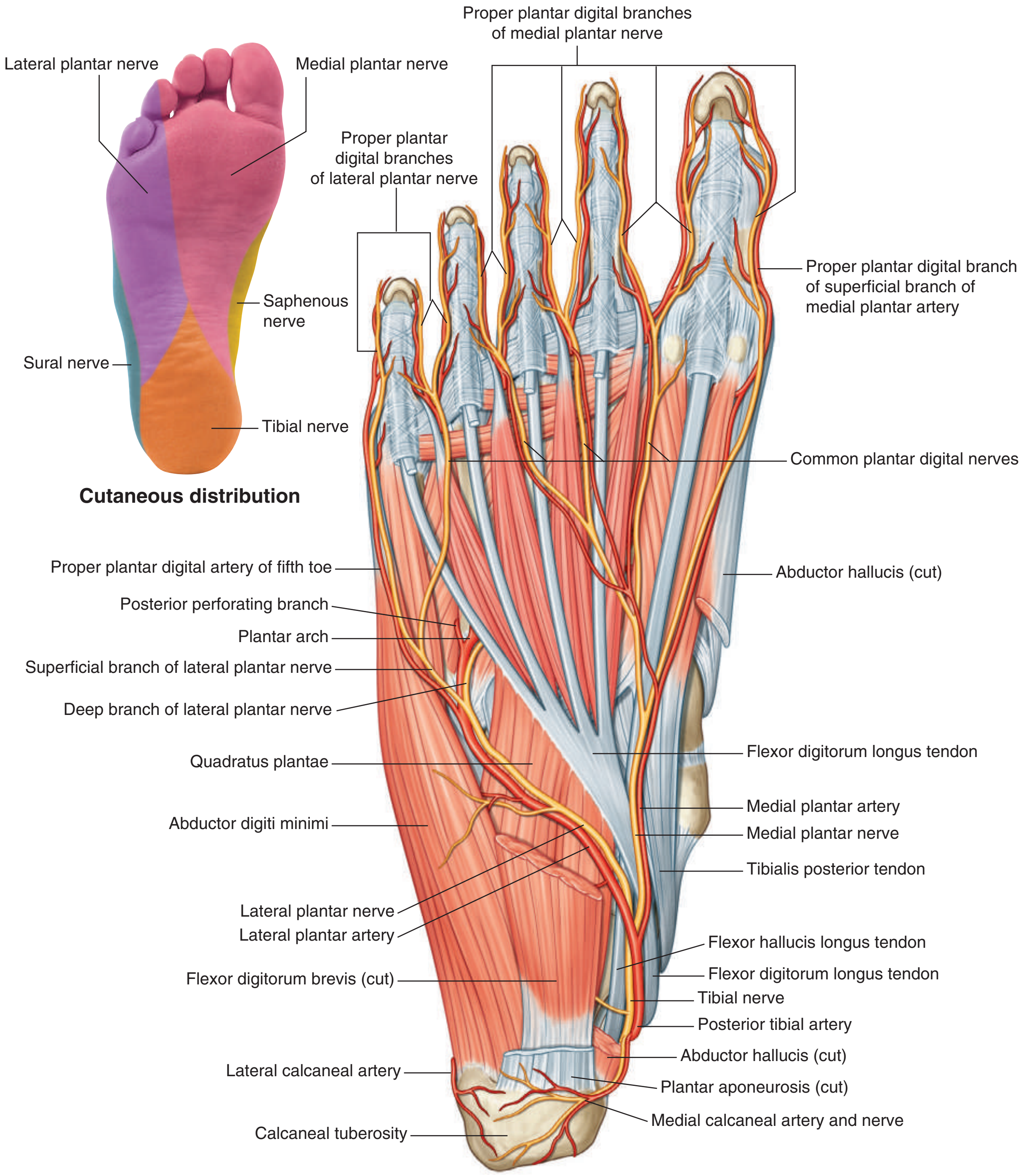

Proper plantar digital branches of medial plantar nerve
Lateral plantar nerve
Medial plantar nerve
Proper plantar digital branches of lateral plantar nerve
Saphenous nerve
Sural nerve
Tibial nerve
Cutaneous distribution
Proper plantar digital branch of superficial branch of medial plantar artery
Common plantar digital nerves
Abductor hallucis (cut)
Proper plantar digital artery of fifth toe
Posterior perforating branch
Plantar arch
Superficial branch of lateral plantar nerve
Deep branch of lateral plantar nerve
Quadratus plantae
Flexor digitorum longus tendon
Medial plantar artery
Medial plantar nerve
Abductor digiti minimi
Tibialis posterior tendon
Lateral plantar nerve
Lateral plantar artery
Flexor hallucis longus tendon
Flexor digitorum brevis (cut)
Flexor digitorum longus tendon
Tibial nerve
Posterior tibial artery
Abductor hallucis (cut)
Lateral calcaneal artery
Plantar aponeurosis (cut)
Medial calcaneal artery and nerve
Calcaneal tuberosity

Plate 19.1 Arteries and nerves of the sole of the foot.

- Continue the dissection by transecting the quadratus plantae muscle close to its calcaneal origin (Fig. 19.12).
- Reflect the transected muscle toward the toes (Fig. 19.13).
- Clean the small amounts of fascia and fat (Fig. 19.14).
- Identify the two heads of the **adductor hallucis** muscle, the oblique head and transverse head (see Fig. 19.14).
- Posterior to the two heads of the adductor hallucis muscle, identify the fibularis longus tendon and its attachments (see Fig. 19.14).
- Cut the tendon of the flexor hallucis longus muscle, and reflect it toward the great toe, exposing the **flexor hallucis brevis** muscle underneath.
- On the lateral side of the foot, retract the tendon of the abductor digiti minimi muscle, and medially and deep to it, identify the **flexor digiti minimi brevis** muscle.

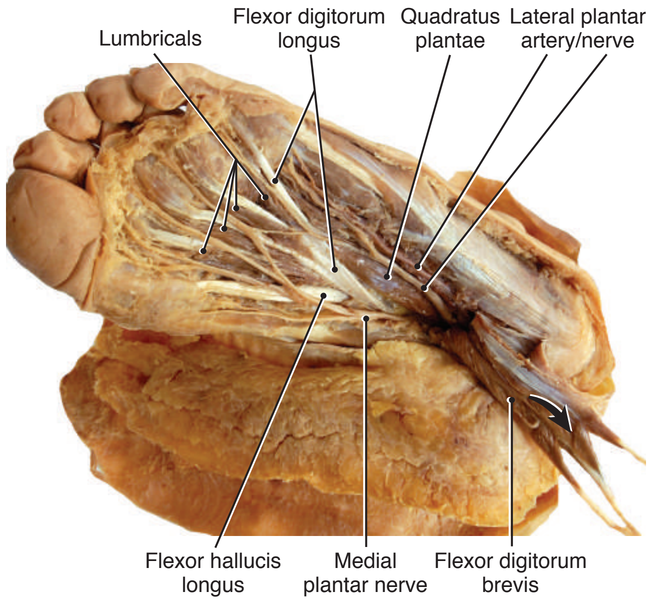

Lumbricals
Flexor digitorum longus
Quadratus plantae
Lateral plantar artery/nerve
Flexor hallucis longus
Medial plantar nerve
Flexor digitorum brevis

Fig. 19.10 View highlighting tendon of flexor hallucis longus muscle on medial side of foot.

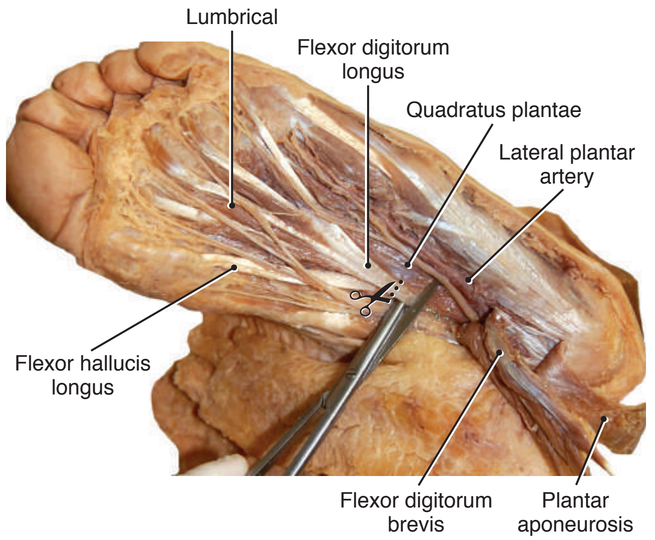

Lumbrical
Flexor digitorum longus
Quadratus plantae
Lateral plantar artery
Flexor hallucis longus
Flexor digitorum brevis
Plantar aponeurosis

Fig. 19.11 Tendon of flexor digitorum longus incised at posterior aspect of foot near calcaneus.

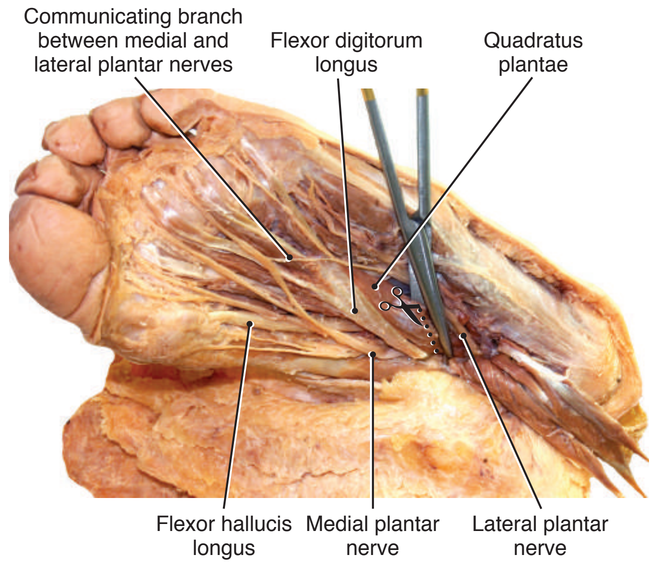

Communicating branch between medial and lateral plantar nerves
Flexor digitorum longus
Quadratus plantae
Flexor hallucis longus
Medial plantar nerve
Lateral plantar nerve

Fig. 19.12 Quadratus plantae muscle transected.

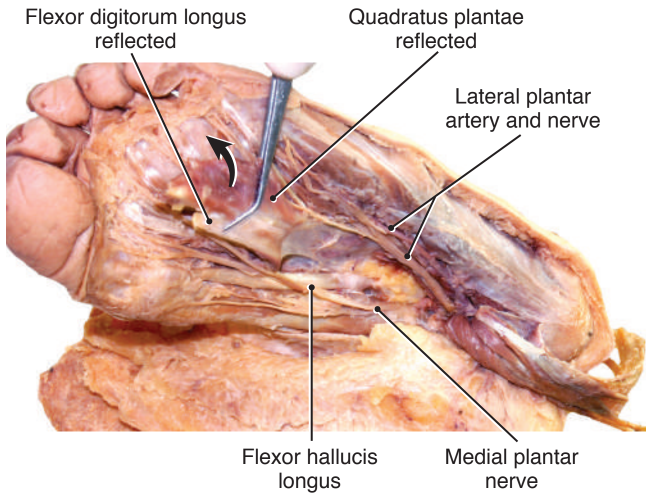

Flexor digitorum longus reflected
Quadratus plantae reflected
Lateral plantar artery and nerve
Flexor hallucis longus
Medial plantar nerve

Fig. 19.13 Quadratus plantae muscle reflected toward the toes.

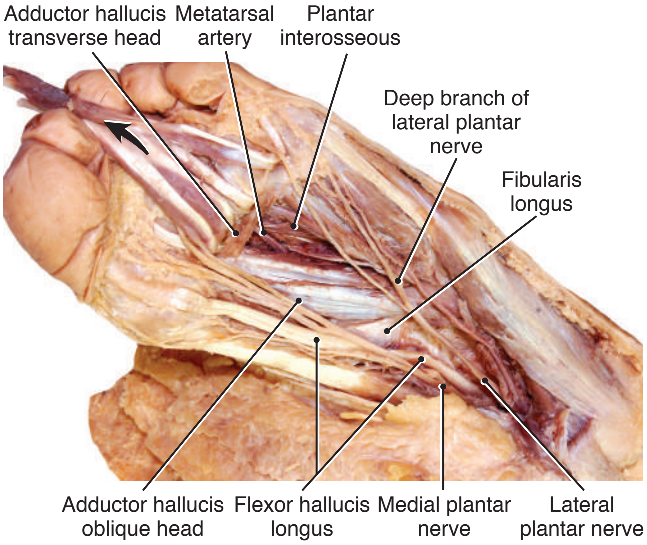

Adductor hallucis transverse head
Metatarsal artery
Plantar interosseous
Deep branch of lateral plantar nerve
Fibularis longus
Adductor hallucis oblique head
Flexor hallucis longus
Medial plantar nerve
Lateral plantar nerve

Fig. 19.14 Tendon of flexor hallucis longus reflected toward the great toe, exposing the flexor hallucis brevis muscle; tendon of abductor digiti minimi reflected to locate the flexor digiti minimi brevis muscle.

(DEEP) 4TH LAYER OF PLANTAR FOOT MUSCLES

- Trace the **lateral plantar nerve** from its origin to its final distribution, and identify its superficial and **deep branches** (see Fig. 19.1 and Plate 19.2).
- In the space between the two heads of the adductor hallucis muscle, expose the **interosseous muscles** (see Fig. 19.14).
- With scissors, cut the oblique head of the adductor hallucis muscle (Fig. 19.15).
- Fully expose and trace the fibularis longus tendon to its insertion onto the 1st cuneiform and 1st metatarsal bones (Fig. 19.16).

OPTIONAL DISSECTION

- Follow the lateral plantar artery along the lateral plantar nerve and identify the deep branch of the lateral plantar nerve at the lateral side of the oblique head of the adductor hallucis muscle (see Plate 19.1).

ANATOMY **NOTE**

At this point, the lateral plantar artery gives off a branch to form the plantar arch, just underneath the oblique head of the adductor hallucis muscle.

- Identify the **plantar arch** and trace its branches, the **metatarsal branches**, which provide **plantar digital** vessels to the digits (see Plate 19.1).

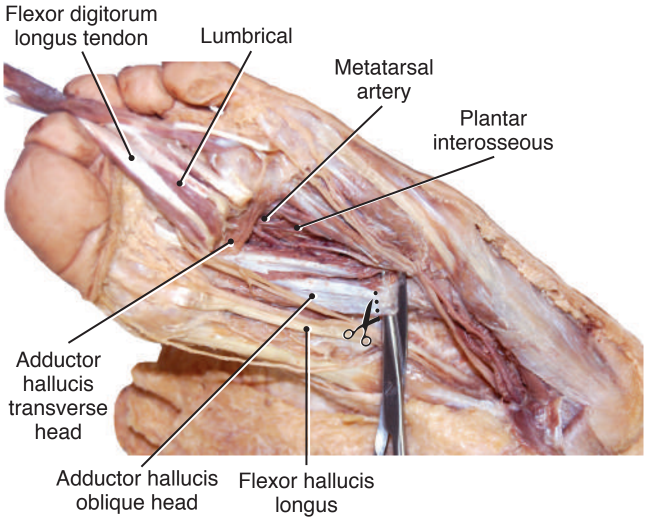

Flexor digitorum longus tendon
Lumbrical
Metatarsal artery
Plantar interosseous
Adductor hallucis transverse head
Adductor hallucis oblique head
Flexor hallucis longus

Fig. 19.15 Plantar interosseous muscles exposed in space between the two heads of the adductor hallucis muscle, with the oblique head cut.

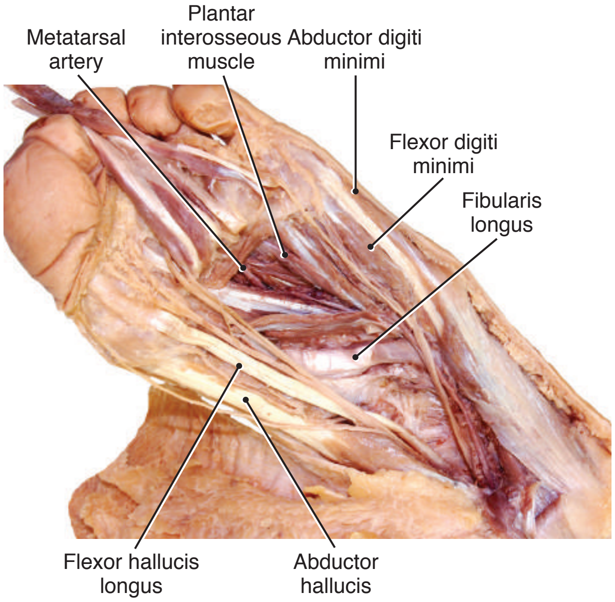

Metatarsal artery
Plantar interosseous muscle
Abductor digiti minimi
Flexor digiti minimi
Fibularis longus
Flexor hallucis longus
Abductor hallucis

Fig. 19.16 Identify the fibularis longus tendon and insertion onto the 1st cuneiform and 1st metatarsal bones.

ANATOMY **NOTE**

In the space between the 1st and 2nd metatarsals, the deep plantar arch joins the plantar branch of the dorsalis pedis artery.

- Follow the plantar arch to the base of the 1st metatarsal and identify the **plantar branch to the dorsalis pedis artery** (see Plate 19.1).

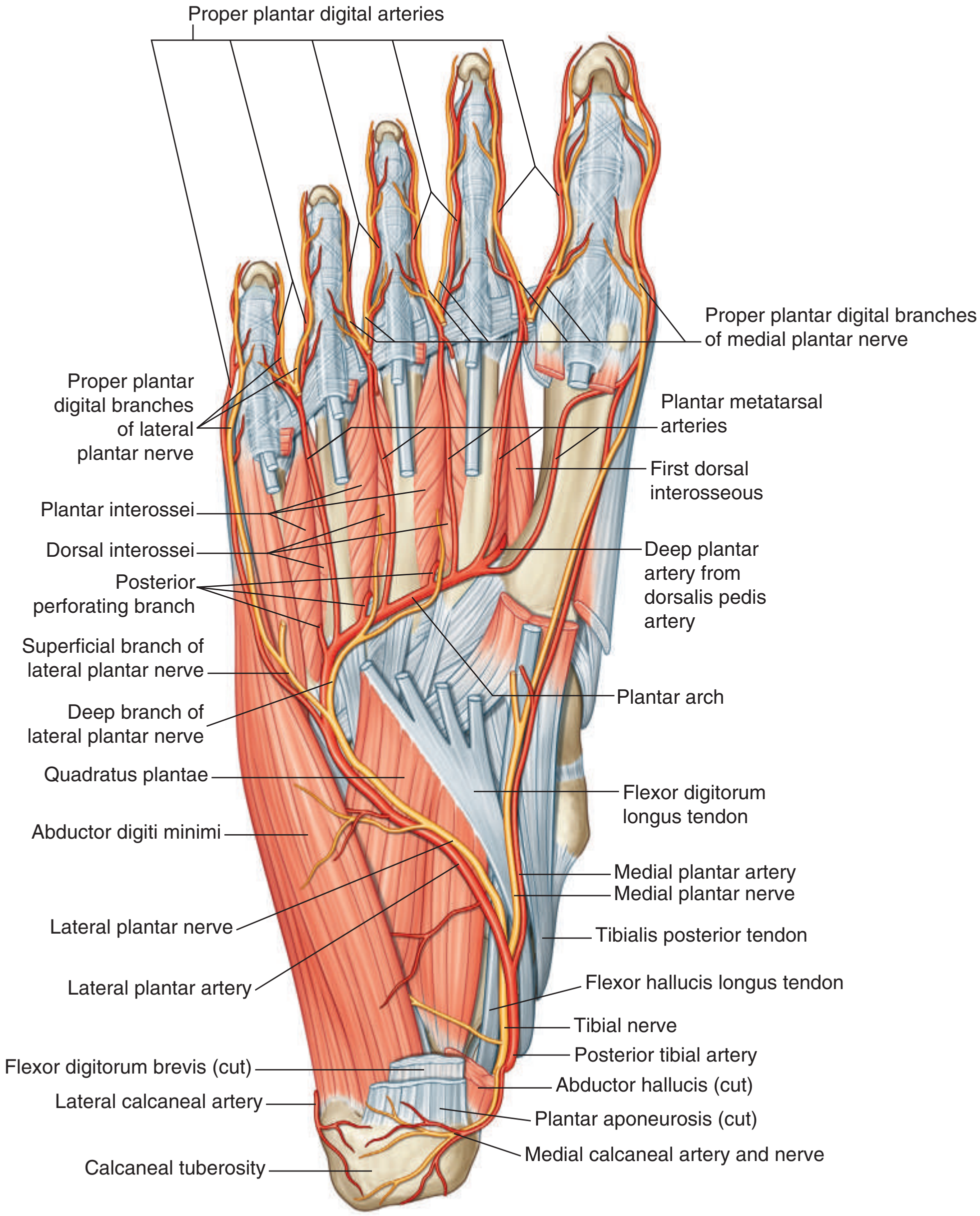

Proper plantar digital arteries
Proper plantar digital branches of medial plantar nerve
Proper plantar digital branches of lateral plantar nerve
Plantar metatarsal arteries
First dorsal interosseous
Plantar interossei
Dorsal interossei
Deep plantar artery from dorsalis pedis artery
Posterior perforating branch
Superficial branch of lateral plantar nerve
Plantar arch
Deep branch of lateral plantar nerve
Quadratus plantae
Flexor digitorum longus tendon
Abductor digiti minimi
Medial plantar artery
Medial plantar nerve
Lateral plantar nerve
Tibialis posterior tendon
Lateral plantar artery
Flexor hallucis longus tendon
Tibial nerve
Posterior tibial artery
Flexor digitorum brevis (cut)
Abductor hallucis (cut)
Lateral calcaneal artery
Plantar aponeurosis (cut)
Medial calcaneal artery and nerve
Calcaneal tuberosity

Plate 19.2 Arteries and nerves of the sole of the foot (deep).

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Medial plantar
  - ☐ Common plantar digital
    - ☐ Plantar digital
- ☐ Lateral plantar
  - ☐ Common plantar digital
    - ☐ Plantar digital
- ☐ Superficial fibular
  - ☐ Dorsal digital branches
- ☐ Deep fibular
  - ☐ Dorsal digital branches
- ☐ Medial calcaneal
- ☐ Lateral calcaneal

ARTERIES

- ☐ Dorsalis pedis
  - ☐ Lateral tarsal
  - ☐ Arcuate
  - ☐ Deep plantar
- ☐ Dorsal metatarsal
  - ☐ Dorsal digital
- ☐ Medial plantar
- ☐ Plantar metatarsal
  - ☐ Common plantar digital
    - ☐ Plantar digital
- ☐ Lateral plantar
- ☐ *Plantar arch*
  - ☐ Plantar metatarsal
    - ☐ Common plantar digital
      - ☐ Plantar digital

VEINS

- ☐ Dorsal venous arch

MUSCLES

- ☐ *Dorsal muscles and tendons*
  - ☐ Extensor hallucis brevis
  - ☐ Extensor digitorum brevis
  - ☐ Extensor hallucis longus tendon
  - ☐ Extensor digitorum longus tendons
  - ☐ Tibialis anterior tendon
- ☐ *Plantar muscles and leg muscle tendons*
- ☐ Abductor hallucis
- ☐ Flexor hallucis brevis
    - ☐ Medial head
    - ☐ Lateral head
- ☐ Flexor hallucis longus tendon
- ☐ Flexor digitorum brevis
- ☐ Flexor digiti minimi brevis
- ☐ Abductor digiti minimi
- ☐ Flexor digitorum longus tendons
- ☐ Quadratus plantae
- ☐ Lumbricals
- ☐ Fibularis longus tendon
- ☐ Tibialis posterior tendon
- ☐ Fibularis brevis tendon
- ☐ Adductor hallucis
  - ☐ Transverse head
  - ☐ Oblique head
- ☐ Plantar interossei
- ☐ Dorsal interossei

LIGAMENTS

- ☐ Plantar calcaneonavicular (spring) ligament
- ☐ Long plantar ligament
- ☐ Plantar calcaneocuboid (short plantar) ligament

CONNECTIVE TISSUE

- ☐ Plantar aponeurosis
- ☐ Inferior extensor retinaculum

BONES

- ☐ *Tarsal bones*
  - ☐ Calcaneus
  - ☐ Talus
  - ☐ Cuboid
  - ☐ Navicular
  - ☐ Medial cuneiform
  - ☐ Middle cuneiform
  - ☐ Lateral cuneiform
  - ☐ Metatarsals
  - ☐ Phalanges
    - ☐ Proximal
    - ☐ Middle
    - ☐ Distal

CLINICAL APPLICATIONS

TROCHANTERIC BURSITIS INJECTION

Gray's Anatomy for Students: 296-299
Netter: 481, 482, 494

Clinical Application

Introduce local anesthetic using an intrabursal injection to relieve pain of inflamed trochanteric bursa.

Anatomic Landmarks (Figs. VII.1 and VII.2)

- Skin
- Subcutaneous tissue
- Iliotibial fascia
- Tensor fasciae latae
- Trochanteric bursa
- Greater trochanter

PREPATELLAR BURSITIS ASPIRATION/ INJECTION

Gray's Anatomy for Students: 325–326
Netter: 498–502

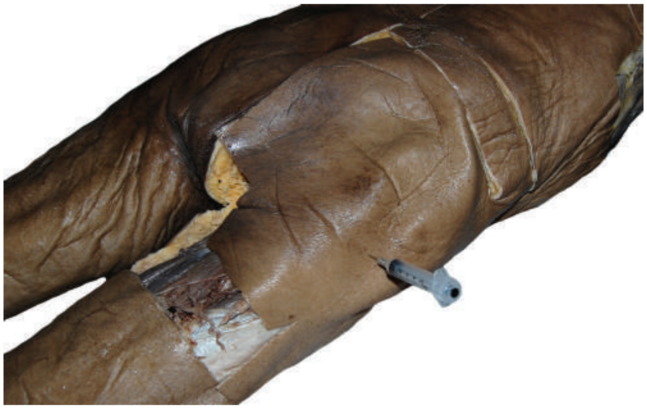


Fig. VII.1

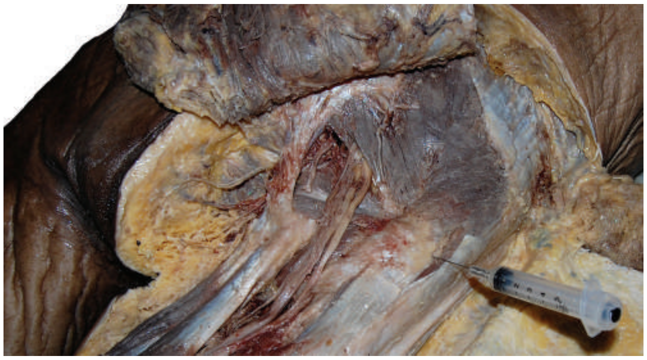


Fig. VII.2

Clinical Application

Introduce local anesthesia into prepatellar bursa to withdraw fluid and relieve pain from prepatellar bursa.

Anatomic Landmarks (Figs. VII.3)

- Skin
- Patella
- Subcutaneous tissue
- Prepatellar bursa

SUPRAPATELLAR BURSITIS ASPIRATION/INJECTION

Gray's Anatomy for Students: 325, 326
Netter: 498, 502

Clinical Application

Introduce local anesthesia into suprapatellar bursa to relieve pain from prepatellar bursa.

Anatomic Landmarks (Fig. VII.4)

- Skin
- Subcutaneous tissue
- Suprapatellar bursa

PLANTAR FASCITIS INJECTION

Gray's Anatomy for Students: 356
Netter: 523

Clinical Application

Injection of local anesthetic at the point of maximal tenderness within the plantar fascia or plantar aponeurosis, often near its attachment to the medial process of the calcaneal tuberosity, to relieve pain caused by inflamed fascia.

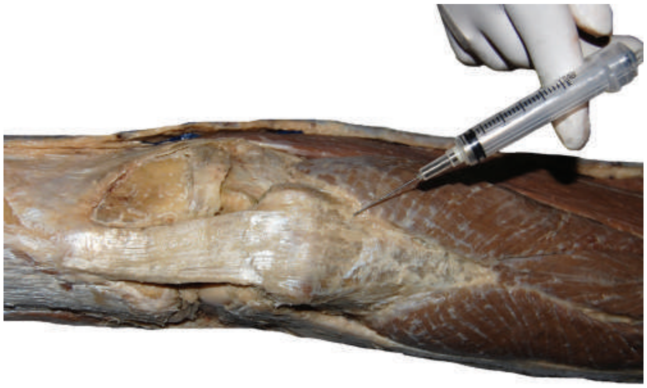


Fig. VII.3

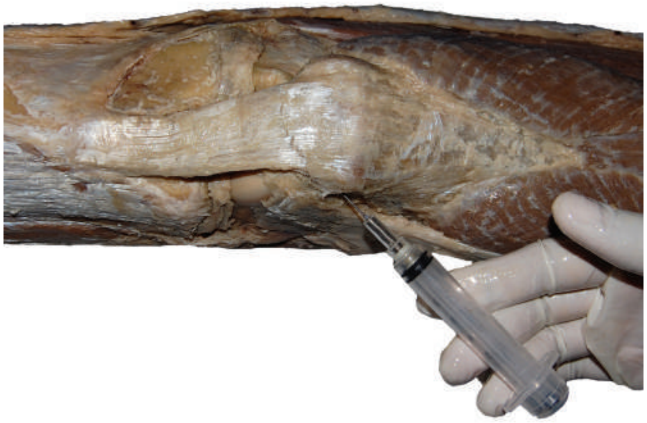


Fig. VII.4

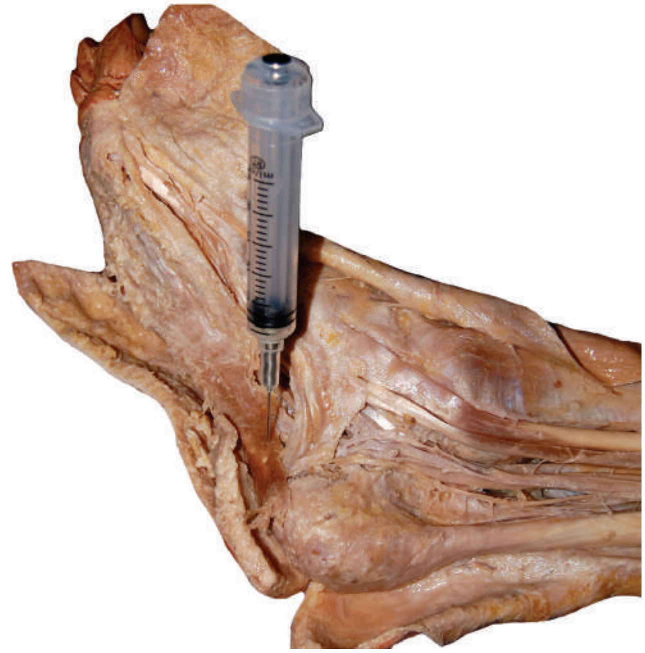


Fig. VII.6

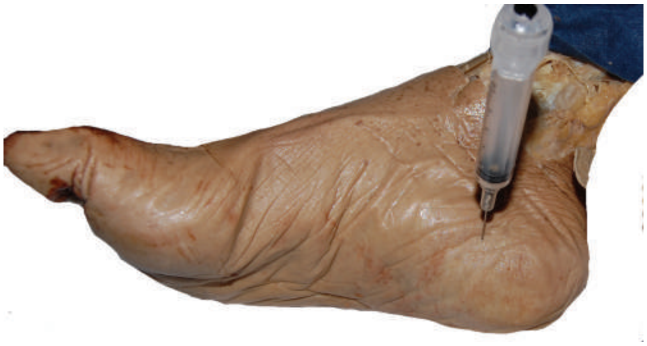


Fig. VII.5

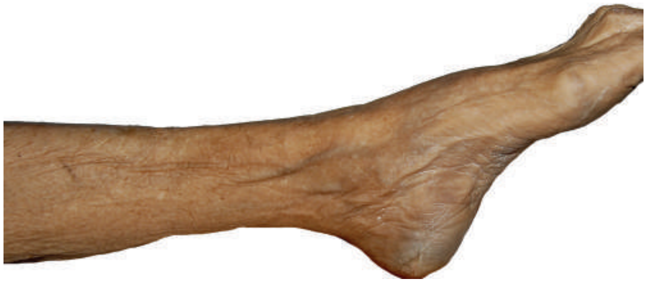


Fig. VII.7

Anatomic Landmarks (Figs. VII.5 and VII.6)

- Skin
- Subcutaneous tissue/fat pad
- Plantar fascia/aponeurosis
- Calcaneal tuberosity

ARTHROCENTESIS: KNEE

Gray's Anatomy for Students: 325, 326
Netter: 498–501

Clinical Application

Introduce needle into the knee joint to withdraw fluid and to inject medication.

Anatomic Landmarks

- Skin
- Subcutaneous tissue
- Patella
- Intercondylar notch
- Joint cavity

GREAT SAPHENOUS VEIN CUTDOWN OR CANNULATION

Gray's Anatomy for Students: 364
Netter: 473, 475

Clinical Application

Procedure to cannulate great saphenous vein for infusion of fluids.

Anatomic Landmarks (Figs. VII.7 and VII.8)

- Medial malleolus
- Skin
- Subcutaneous tissue
- Great saphenous vein
- Saphenous nerve

FEMUR AND KNEE REPLACEMENT

Fig. VII.9 depicts a head of the femur replacement. Fig. VII.10 depicts a knee replacement.

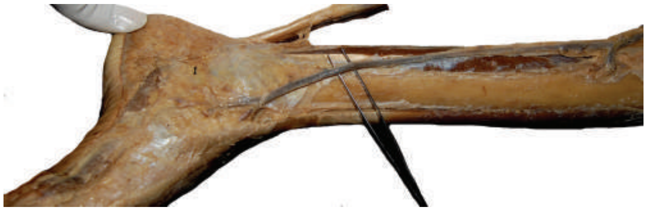
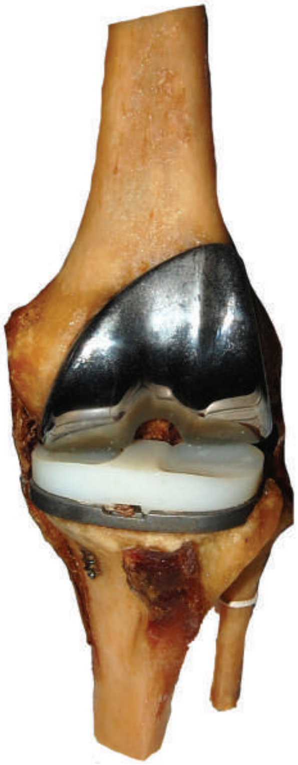


Fig. VII.8



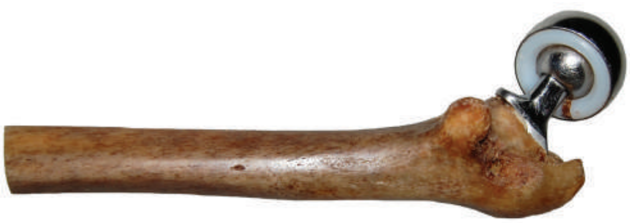


Fig. VII.9

Fig. VII.10

CHAPTER 20 NECK

ATLAS REFERENCES

Netter: 8, 9, 31, 32, 35, 38–41, 141–142
McMinn: 28–37
Gray's Atlas: 536, 539–551

BEFORE YOU BEGIN

Palpate the following landmarks on your neck or the cadaver:

- Mental protuberance
- Hyoid bone
- Laryngeal prominence ("Adam's apple")
- Cricoid cartilage
- Jugular notch
- Thyroid gland

ANATOMIC TRIANGLES

ANATOMY **NOTE**

The neck may be divided into smaller topographic areas, the *triangles* of the neck. Specifically, the "carotid triangle" and the "root of the neck" are involved in many surgical procedures on the neck. There are two major triangles of the neck, the anterior and posterior cervical triangles (Fig. 20.1). The *anterior cervical triangle* is demarcated anteriorly by the midline of the neck; its base is the lower border of the mandible, and the posterior border is the anterior boundary of the sternocleidomastoid muscle. The *posterior cervical triangle* is bounded by the posterior border of the sternocleidomastoid muscle, the middle third of the clavicle, and the anterior border of the trapezius muscle. The cervical triangles may be subdivided as follows:

Anterior cervical triangle

1. Digastric triangle
2. Submental triangle
3. Carotid triangle
4. Muscular triangle

Posterior cervical triangle

5. Occipital triangle
6. Supraclavicular triangle

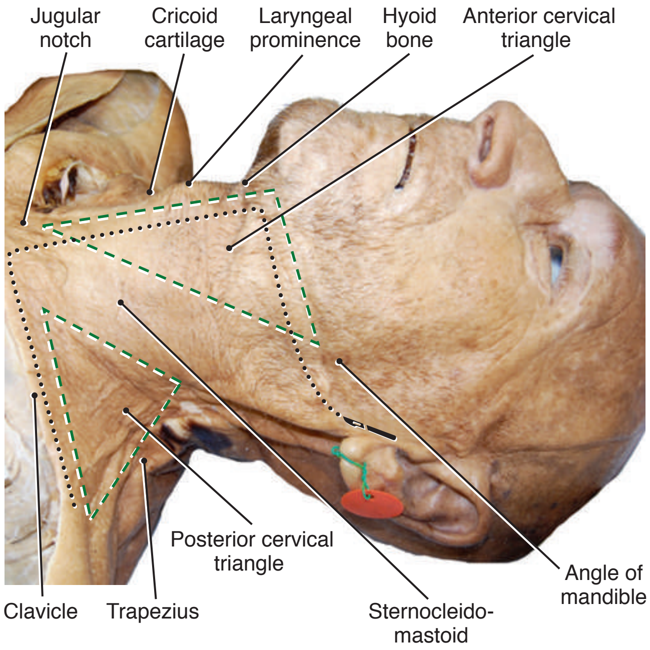


Fig. 20.1 Anterolateral view of surface anatomy of the neck, highlighting hyoid bone, laryngeal prominence, sternal notch, angle of mandible, sternocleidomastoid muscle and anterior and posterior triangles of the neck.

NECK DISSECTION

- ○ **Make a midline incision through the skin from the jugular notch to the mental protuberance.**
- ○ **A second incision should be made from the jugular notch laterally, along the clavicles bilaterally, to the acromion processes.**
- ○ **Make a final incision from the mental protuberance along the inferior border of the mandible, toward the earlobe (Fig. 20.2). Carefully reflect the skin over the neck.**

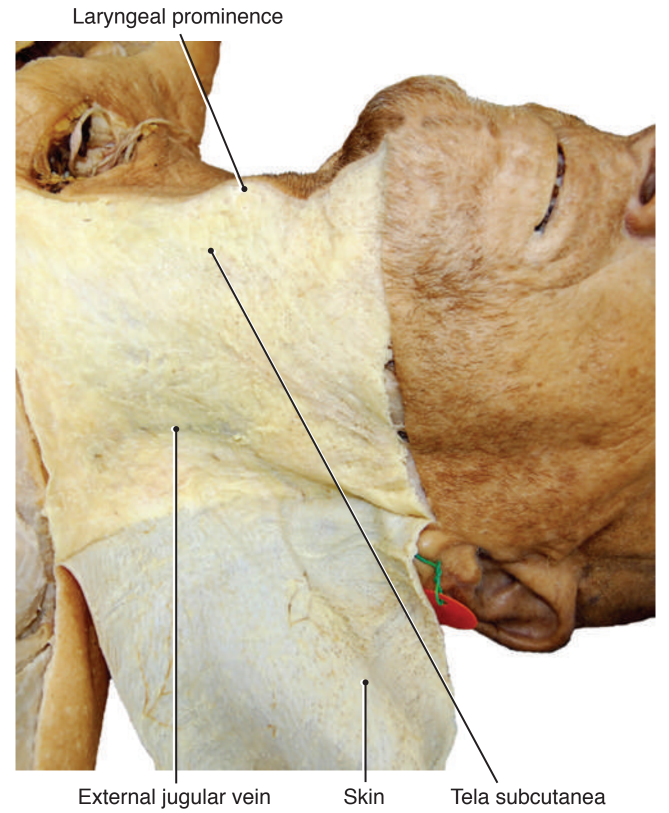
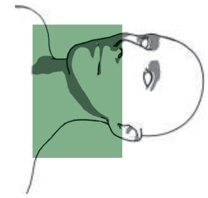

Laryngeal prominence
External jugular vein
Skin
Tela subcutanea

Fig. 20.2 Skin of neck reflected laterally, revealing tela subcutanea (subcutaneous tissue), laryngeal prominence, superficial lobe of submandibular gland, external jugular vein, and midline of the neck.



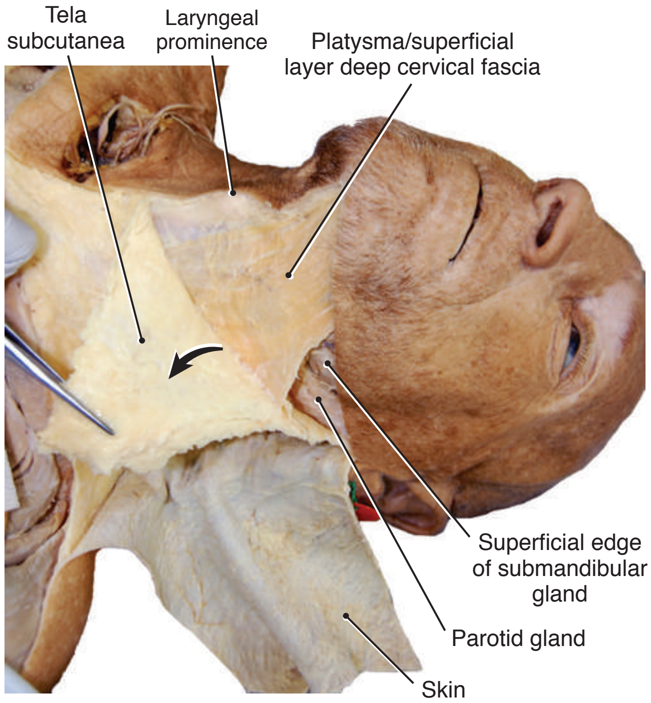

Tela subcutanea
Laryngeal prominence
Platysma/superficial layer deep cervical fascia
Superficial edge of submandibular gland
Parotid gland
Skin

Fig. 20.3 Skin and tela subcutanea reflected laterally, revealing platysma muscle, superficial layer of deep cervical fascia, superficial lobe of submandibular gland and sternocleidomastoid muscle.

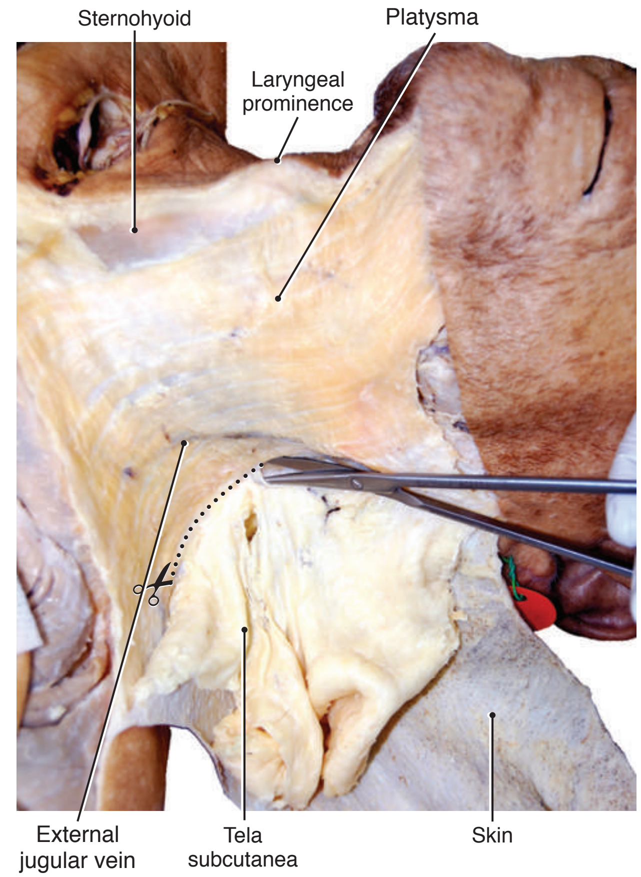
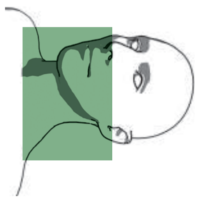

Sternohyoid
Platysma
Laryngeal prominence
External jugular vein
Tela subcutanea
Skin

Fig. 20.4 Separation of lateral border of platysma muscle from tela subcutanea.



DISSECTION **TIP**

The skin over the neck is thin. Pay special attention during its reflection for the subcutaneous tissue so that you do not reflect the platysma muscle with the skin.

- Start the dissection by reflecting the subcutaneous tissue from the mental protuberance inferiorly and laterally toward the clavicles to expose the platysma muscle (Fig. 20.3).
- The platysma is pierced by the transverse cervical and supraclavicular nerves of the cervical plexus. Reflect the subcutaneous tissue over the platysma muscle (Fig. 20.4).
- Separate the lateral border of the platysma from the subcutaneous tissue. Identify the sternocleidomastoid muscle posterior to the platysma muscle.
- At the level of the clavicle, cut and reflect the platysma upward, toward the mandible (Figs. 20.5 and 20.6).
- Similarly, at the angle of the mandible, cut and reflect the platysma anteriorly (Fig. 20.7).

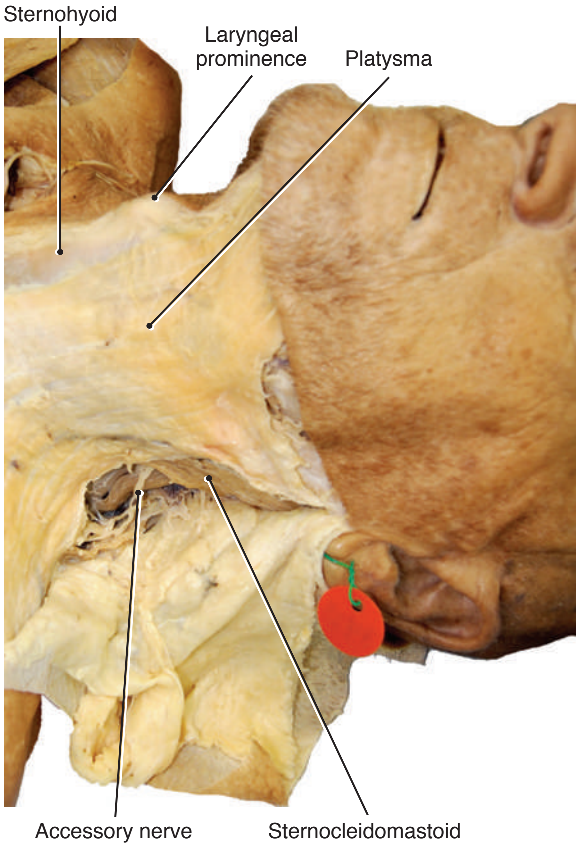
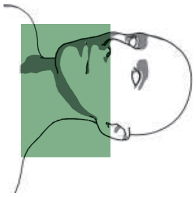


Fig. 20.5 Identification of accessory nerve at interval junction between platysma, sternocleidomastoid, and trapezius muscles.



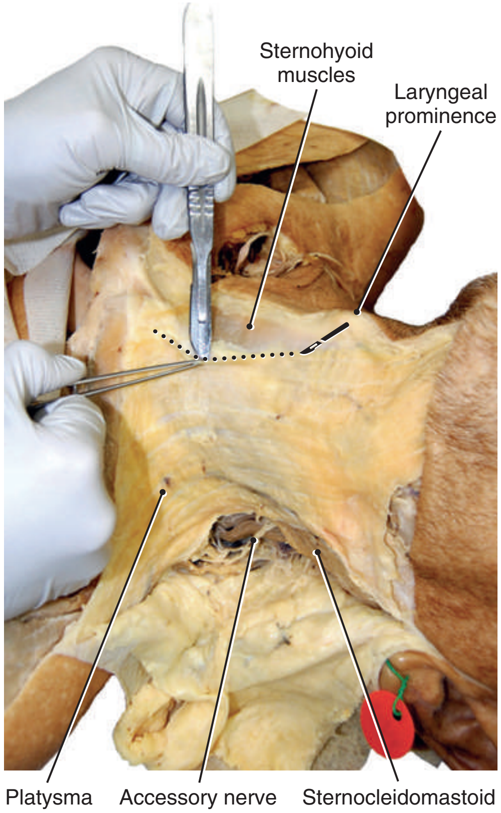
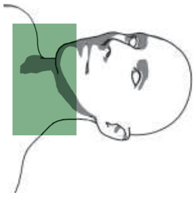


Fig. 20.6 Dissection of medial border of platysma muscle from underlying tissues.



- Preserve the attachment of the platysma muscle along the mandible (Fig. 20.8).

DISSECTION **TIP**

At this stage, it is possible to identify the cervical branch of the facial nerve, which innervates the platysma muscle, coursing from the inferior border of the parotid gland toward the platysma.

- About 1 cm inferior to the angle of the mandible, expose the marginal mandibular branch of the facial nerve.

ANATOMY **NOTE**

The cervical branch of the facial nerve passes superficial to the facial vein and artery. The facial vein usually drains into the internal jugular vein through the retromandibular vein.

- Notice the investing *cervical fascia* covering the sternocleidomastoid muscle (see Fig. 20.8). Observe the external jugular vein running lateral to the sternocleidomastoid muscle.

ANATOMY **NOTE**

The investing cervical fascia encircles the trapezius and sternocleidomastoid muscles before reaching the midline of the neck. In the gap between these muscles, this fascia forms the "roof" of the posterior cervical triangle. The "floor" of the posterior cervical triangle is provided by another fascia, the *prevertebral fascia,* which covers the musculature of the lateral and anterior aspects of the vertebral column. Between these two fascial layers there is a potential space.

- Clean the superficial investing fascia over the sternocleidomastoid muscle (Fig. 20.9 and Plate 20.1).

DISSECTION **TIP**

Use care when you reflect the fascia not to sever any of the cutaneous nerves arising deep to the posterior edge of the sternocleidomastoid muscle.

- Identify the external jugular vein running superficial to the sternocleidomastoid muscle, as well as the

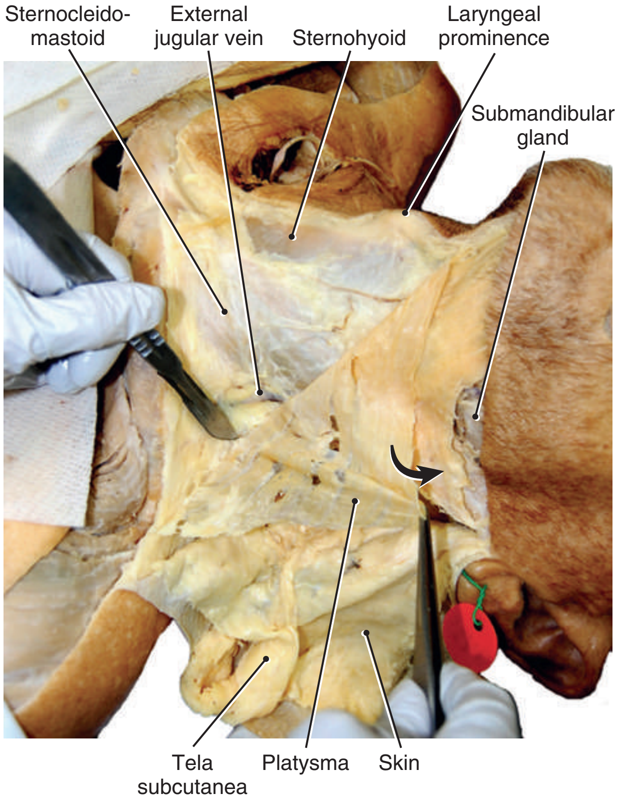
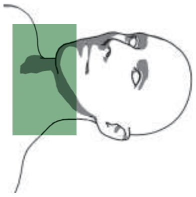

Sternocleido-
mastoid
External
jugular vein
Sternohyoid
Laryngeal
prominence
Submandibular
gland
Tela
subcutanea
Platysma
Skin

Fig. 20.7 Anterolateral view of neck with skin, tela subcutanea, and platysma reflected laterally, revealing sternocleidomastoid muscle, external jugular vein, sternohyoid muscle, thyroid cartilage, and submandibular gland.



following cutaneous nerve branches of the cervical plexus:

- Lesser occipital nerve (C2-C3)
- Great auricular nerve (C2-C3)
- Transverse cervical nerve (C2-C3)
- Supraclavicular nerves (C3-C4)

- These nerves emerge, from top to bottom, along the posterior border of the sternocleidomastoid muscle in the following order: the lesser occipital, great auricular, and transverse cervical nerves.
- Once you expose these nerves, look for the accessory nerve; it appears posterior to the sternocleidomastoid, about two-thirds the distance up its posterior edge, and then crosses the posterior triangle to reach the trapezius muscle.

DISSECTION TIP

In many specimens the transverse cervical nerve, which is a cutaneous nerve, communicates with the cervical branch of the facial nerve, which is a motor nerve.

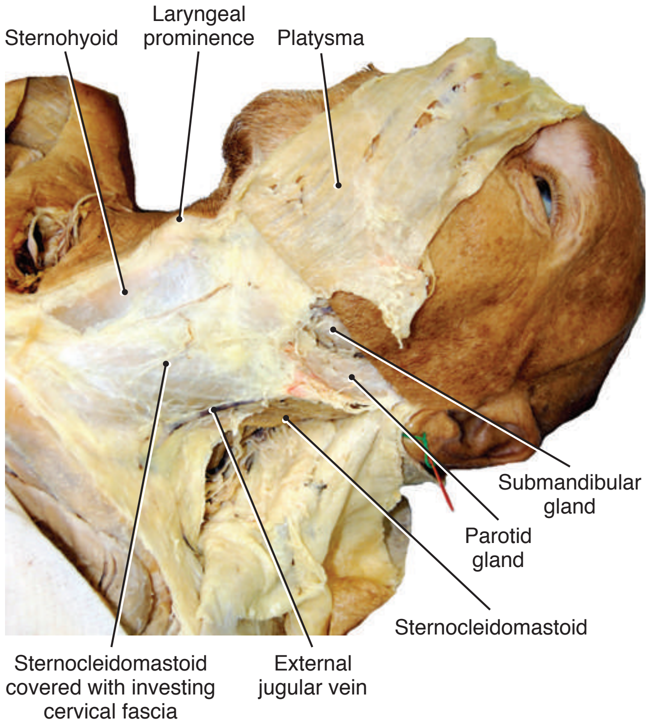

Sternohyoid
Laryngeal
prominence
Platysma
Submandibular
gland
Parotid
gland
Sternocleidomastoid
Sternocleidomastoid
covered with investing
cervical fascia
External
jugular vein

Fig. 20.8 Complete reflection of platysma muscle and exposure of underlying structures.

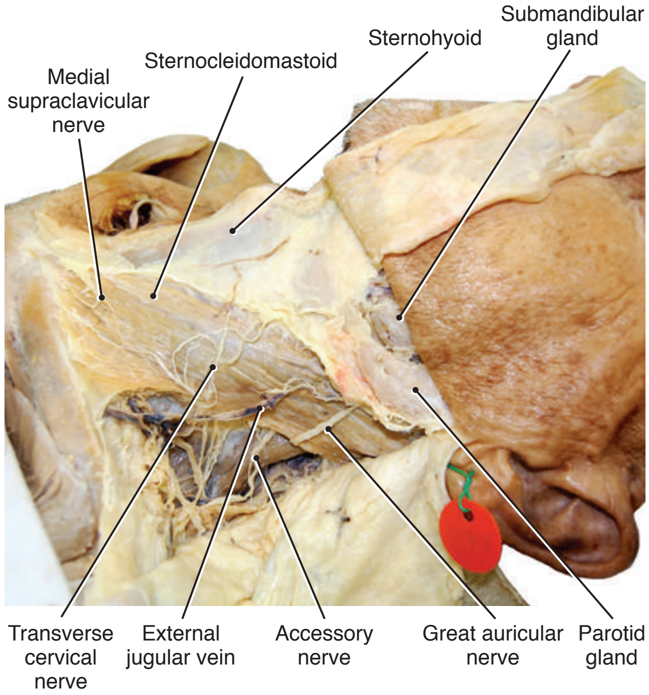
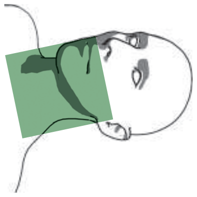

Medial
supraclavicular
nerve
Sternocleidomastoid
Sternohyoid
Submandibular
gland
Transverse
cervical
nerve
External
jugular vein
Accessory
nerve
Great auricular
nerve
Parotid
gland

Fig. 20.9 Anterolateral view of neck with skin and tela subcutanea reflected laterally and platysma reflected superiorly.



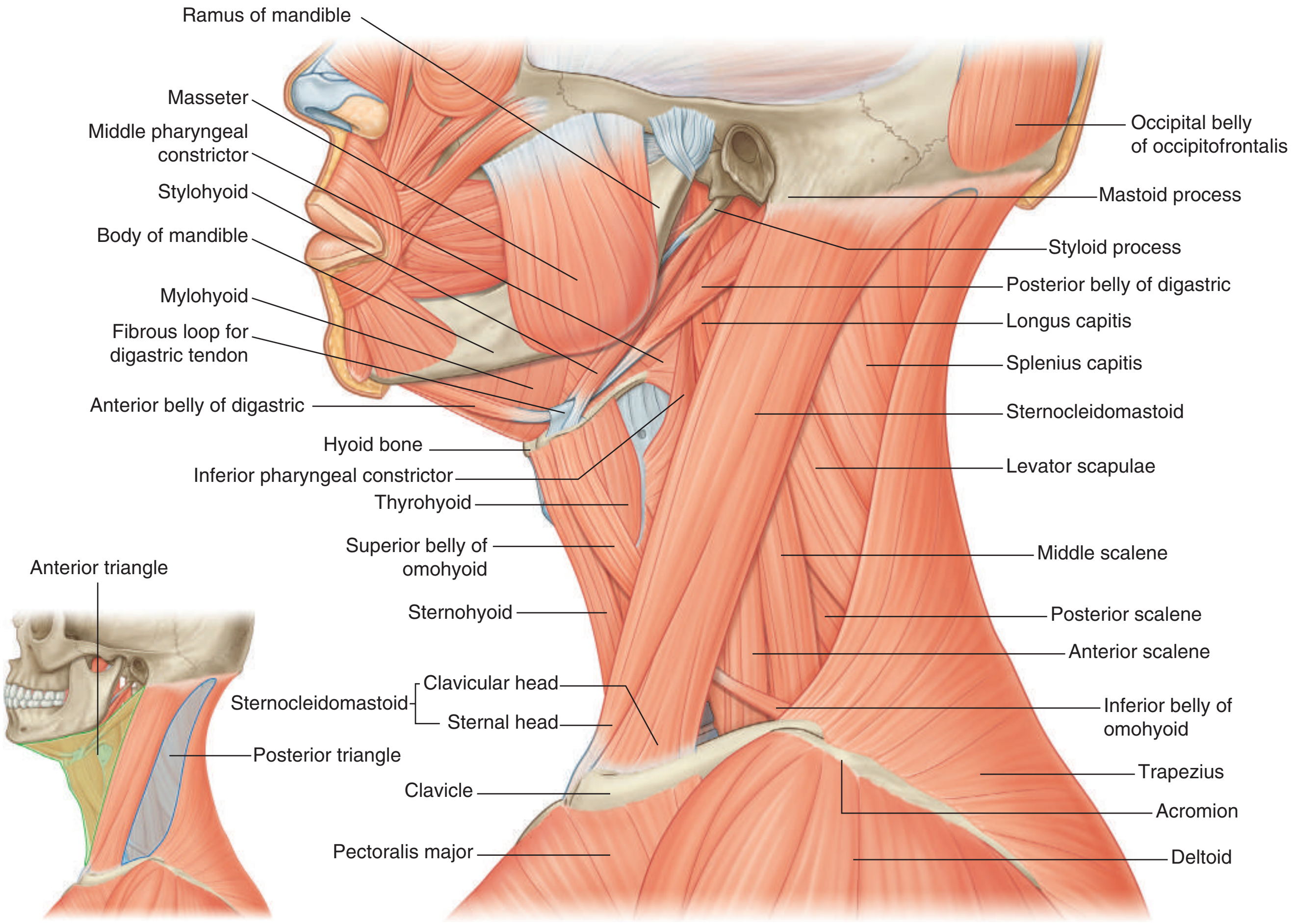

Ramus of mandible
Masseter
Middle pharyngeal constrictor
Stylohyoid
Body of mandible
Mylohyoid
Fibrous loop for digastric tendon
Anterior belly of digastric
Hyoid bone
Inferior pharyngeal constrictor
Thyrohyoid
Superior belly of omohyoid
Sternohyoid
Anterior triangle
Sternocleidomastoid
Clavicular head
Sternal head
Posterior triangle
Clavicle
Pectoralis major
Occipital belly of occipitofrontalis
Mastoid process
Styloid process
Posterior belly of digastric
Longus capitis
Splenius capitis
Sternocleidomastoid
Levator scapulae
Middle scalene
Posterior scalene
Anterior scalene
Inferior belly of omohyoid
Trapezius
Acromion
Deltoid

Plate 20.1 Lateral view of the muscles and triangle of the neck.

- Identify the external jugular vein, which arises at the junction of the posterior auricular vein and the posterior division of the retromandibular vein. This vein terminates in the subclavian vein.

DISSECTION TIP

The external jugular vein may be absent in the presence of a large anterior jugular vein.

- With scissors, detach the medial border of the sternocleidomastoid muscle from its fascial investment (Fig. 20.10).
- Cut the origin of the sternocleidomastoid muscle from the clavicle and the manubrium of the sternum (Fig. 20.11).
- Reflect the sternocleidomastoid muscle upward, away from its fascia. Leave the posterior layer of the superficial cervical fascia intact.
- Trace the accessory nerve from the posterior aspect of the sternocleidomastoid muscle, and preserve this nerve for later dissection.
- Dissect out the fascia, and separate the parotid gland from the sternocleidomastoid muscle without damaging the great auricular and lesser occipital nerves.

ANATOMY NOTE

In some specimens the accessory nerve will exhibit communications with C3 and C4 ventral rami. The accessory nerve in the posterior triangle is found between the superficial investing fascia and the prevertebral fascia.

DISSECTION TIP

In some cadavers the parotid gland may cover the most proximal portion of the sternocleidomastoid muscle (Fig. 20.12). It is important to separate the parotid gland from the sternocleidomastoid to reflect the muscle as laterally as possible. The more the sternocleidomastoid is reflected, the more space that will be available for later dissection.

- Reflect the superficial layer of the investing fascia, and note its contribution to the formation of the carotid sheath (Fig. 20.13).

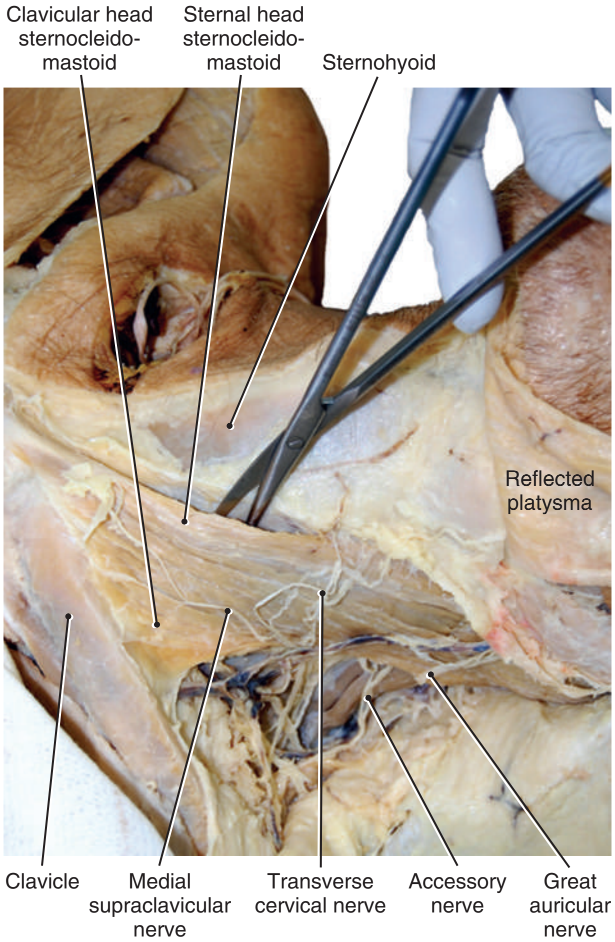
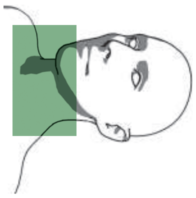

Clavicular head sternocleido-mastoid
Sternal head sternocleido-mastoid
Sternohyoid
Reflected platysma
Clavicle
Medial supraclavicular nerve
Transverse cervical nerve
Accessory nerve
Great auricular nerve

Fig. 20.10 Medial border of underlying tissues detached.



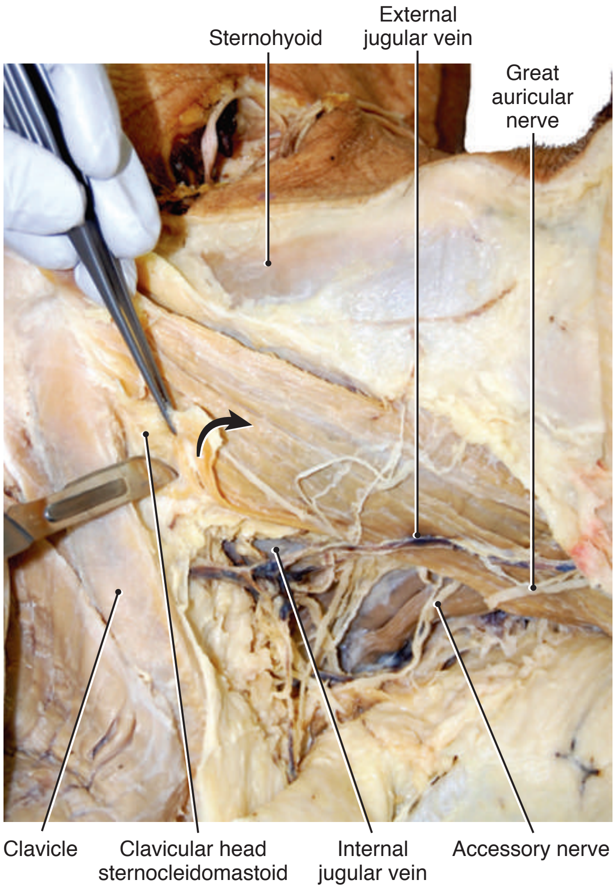
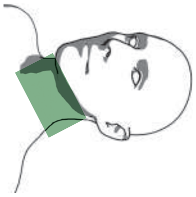

Sternohyoid
External jugular vein
Great auricular nerve
Clavicle
Clavicular head sternocleidomastoid
Internal jugular vein
Accessory nerve

Fig. 20.11 Sternocleidomastoid muscle detached from clavicle.



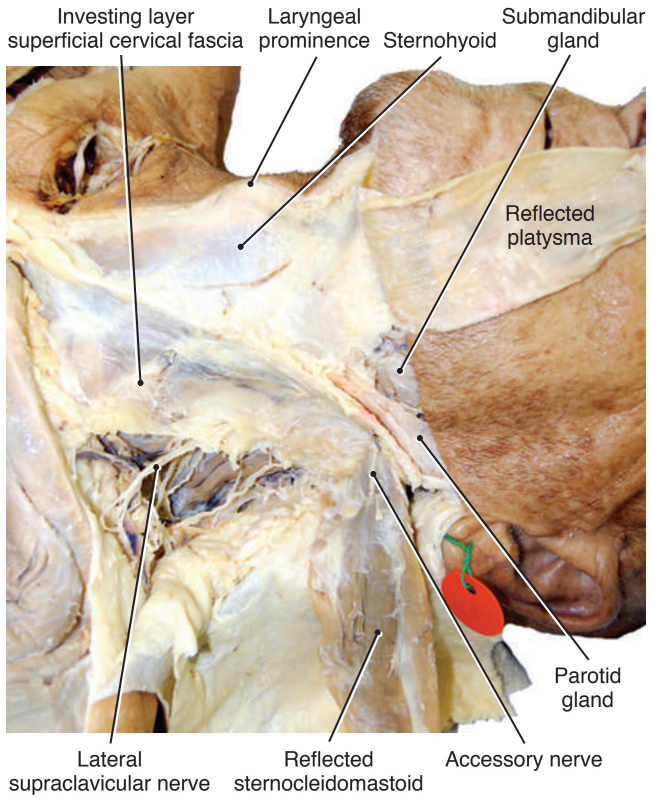
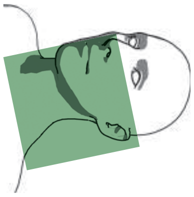

Investing layer superficial cervical fascia
Laryngeal prominence
Sternohyoid
Submandibular gland
Reflected platysma
Parotid gland
Lateral supraclavicular nerve
Reflected sternocleidomastoid
Accessory nerve

Fig. 20.12 Anterolateral view of neck with skin, tela subcutanea, and sternocleidomastoid muscle reflected laterally and platysma reflected superiorly.



- ○ **Identify the carotid sheath, omohyoid muscle, and internal jugular vein.**
- ○ **Clean the carotid sheath over the internal jugular vein.**

DISSECTION **TIP**

As you expose the internal jugular vein from the carotid sheath and superficial layer of the investing cervical fascia, look for the deep cervical lymph nodes. These lymph nodes are often prominent where the omohyoid crosses the internal jugular vein (jugulo-omohyoid node) and where the digastric muscle crosses the internal jugular vein (jugulodigastric node).

- ○ **Identify the *ansa cervicalis*. The ansa cervicalis usually lies superficial to the internal jugular vein, outside the carotid sheath (Fig. 20.14). There are two techniques for the identification of the ansa cervicalis:**
  1. Look superficial and lateral to the internal jugular vein in the lower part of the neck, and identify the ansa cervicalis.
  2. Identify and clean the strap muscles. Follow their nerve supply backward, and trace it to the ansa cervicalis. Specifically, identify the sternohyoid muscle, and follow its small nerve branches proximally.

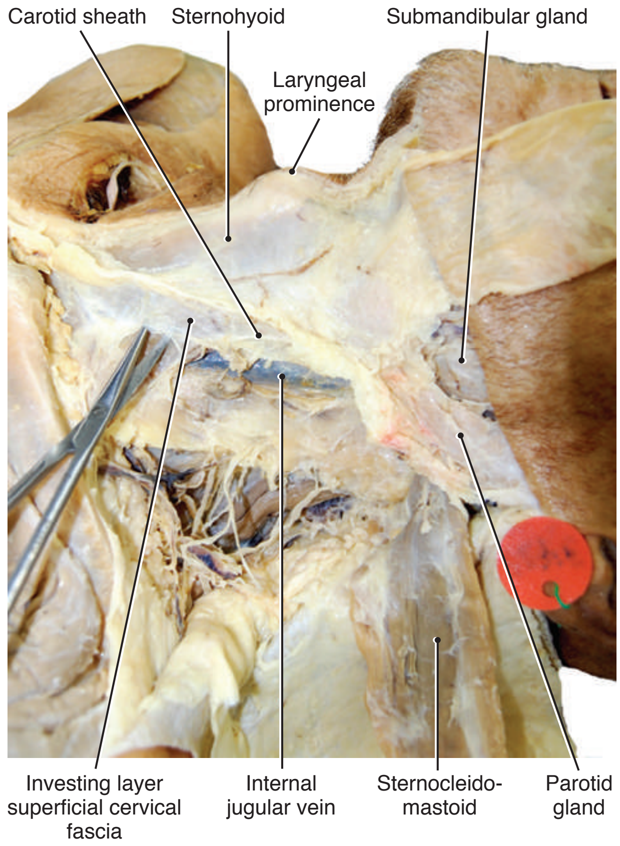
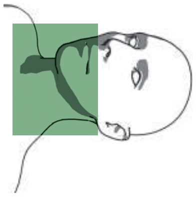

Carotid sheath
Sternohyoid
Submandibular gland
Laryngeal prominence
Investing layer superficial cervical fascia
Internal jugular vein
Sternocleido-mastoid
Parotid gland

Fig. 20.13 Carotid sheath cleaned over internal jugular vein.

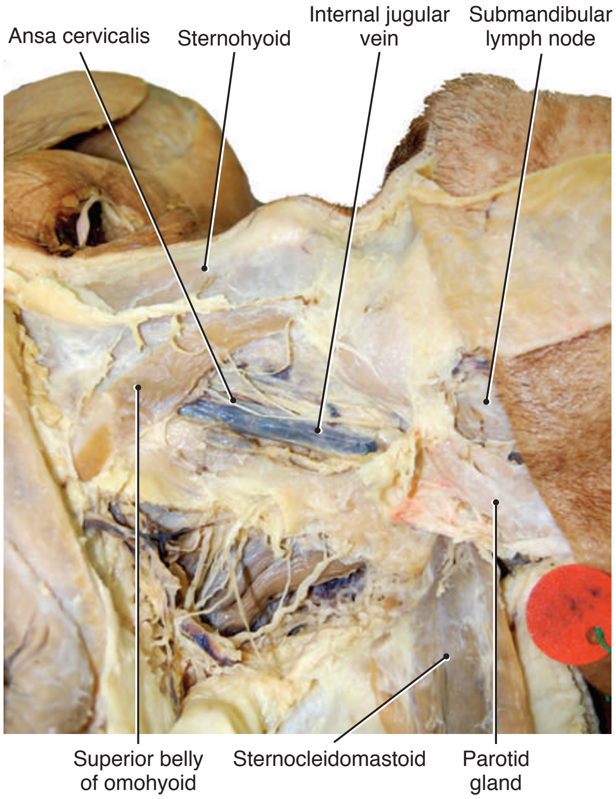


- ○ **Pull the internal jugular vein laterally, and expose the other contents of the carotid sheath, the *vagus nerve* and *common carotid artery* (Fig. 20.15).**
- ○ **Clean the connective tissue, and identify the "strap muscles": the omohyoid (superior and inferior bellies), sternohyoid, sternothyroid, and thyrohyoid muscles (Fig. 20.16).**
- ○ **Clear away the carotid sheath, and fully expose the internal jugular vein, common carotid artery, and vagus nerve (Fig. 20.17).**

DISSECTION **TIP**

With scissors, pull the common carotid artery from the carotid sheath (see Fig. 20.17), to avoid severing important arteries and nerves.

- ○ **Clean the connective tissue, fat, and carotid sheath, and expose the cervical plexus (Fig. 20.18).**


Ansa cervicalis
Sternohyoid
Internal jugular vein
Submandibular lymph node
Superior belly of omohyoid
Sternocleidomastoid
Parotid gland

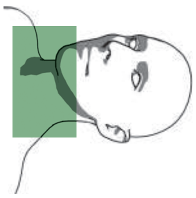
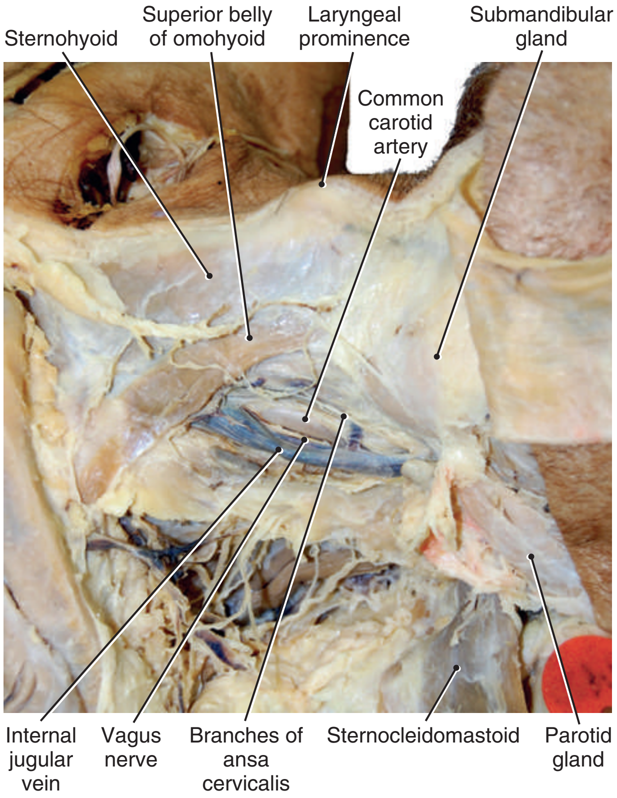


Fig. 20.14 Superior belly of omohyoid muscle exposed, revealing ansa cervicalis superficial to internal jugular vein.


Sternohyoid
Superior belly of omohyoid
Laryngeal prominence
Submandibular gland
Common carotid artery
Internal jugular vein
Vagus nerve
Branches of ansa cervicalis
Sternocleidomastoid
Parotid gland

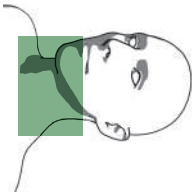


Fig. 20.15 Anterolateral view of neck with skin, tela subcutanea, and sternocleidomastoid muscle reflected laterally and platysma muscle reflected superiorly. Internal jugular vein pulled laterally to expose the other contents of the carotid sheath: vagus nerve and common carotid artery.

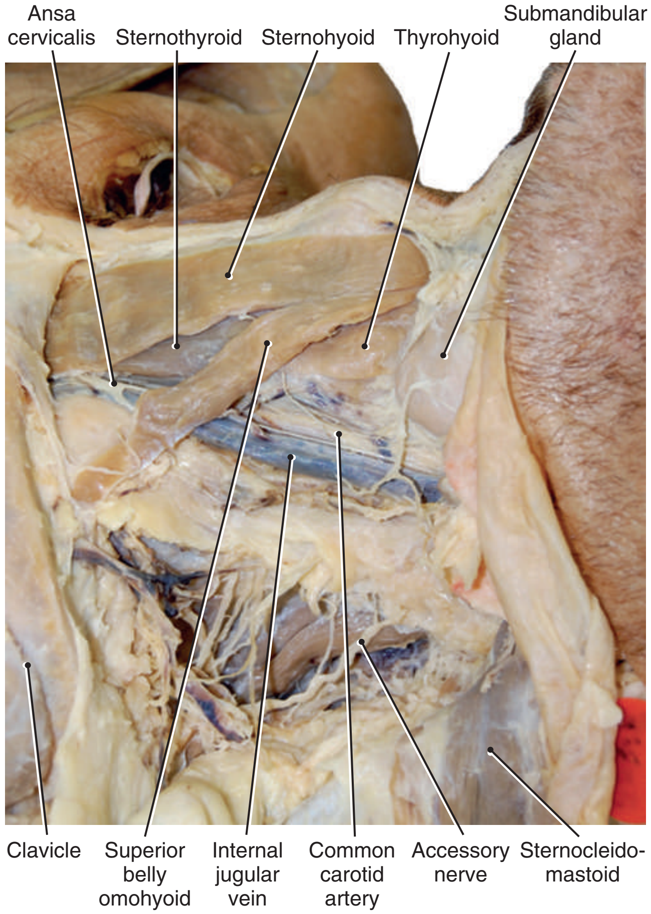
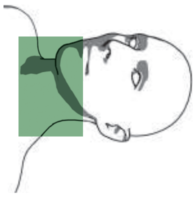

Ansa cervicalis
Sternothyroid
Sternohyoid
Thyrohyoid
Submandibular gland
Clavicle
Superior belly omohyoid
Internal jugular vein
Common carotid artery
Accessory nerve
Sternocleido-mastoid

Fig. 20.16 Connective tissue cleaned, highlighting strap muscles (omohyoid superior/inferior bellies, sternohyoid, sternothyroid, thyrohyoid).



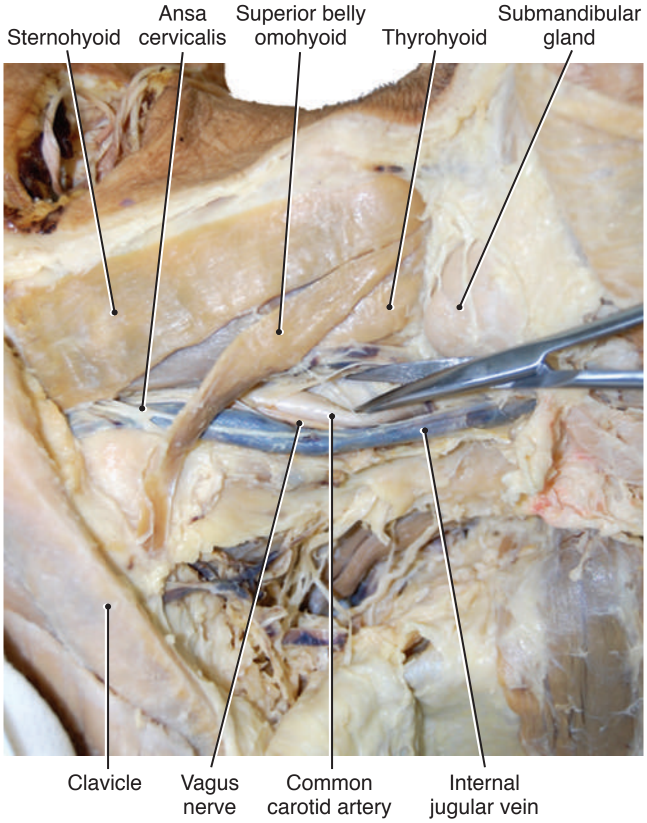
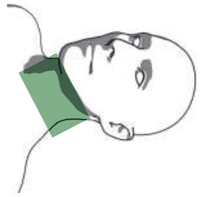

Sternohyoid
Ansa cervicalis
Superior belly omohyoid
Thyrohyoid
Submandibular gland
Clavicle
Vagus nerve
Common carotid artery
Internal jugular vein

Fig. 20.17 Remaining carotid sheath cleaned, fully exposing vagus nerve and carotid artery.



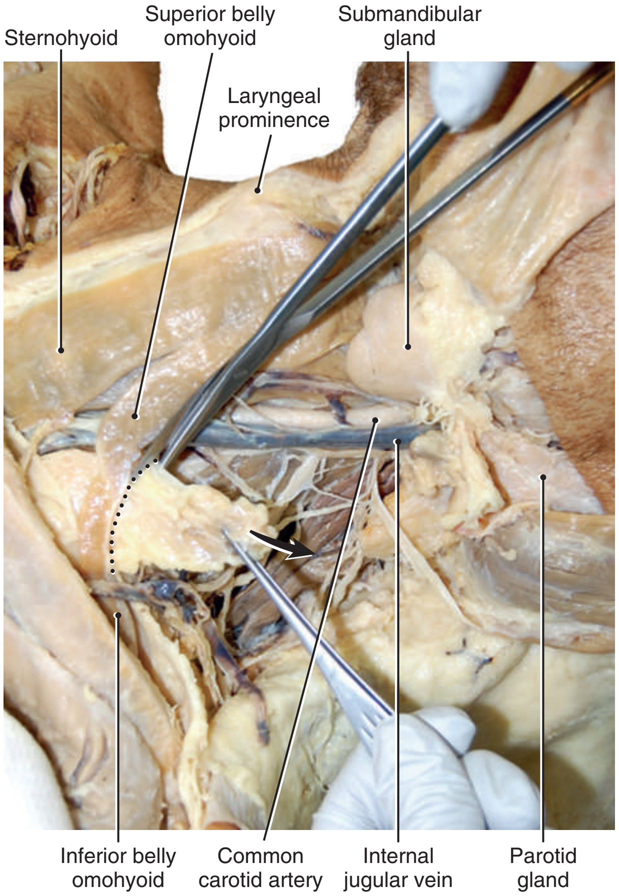
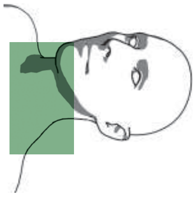

Sternohyoid
Superior belly omohyoid
Submandibular gland
Laryngeal prominence
Inferior belly omohyoid
Common carotid artery
Internal jugular vein
Parotid gland

Fig. 20.18 Adipose tissue removed from posterior cervical triangle, leaving intact nerves and arteries.



- Continue the exposure of the contents of the carotid sheath toward the clavicle (Fig. 20.19).
- Identify the submandibular gland, and pull it toward the midline.
- Clean the carotid sheath toward the angle of the mandible, and identify (if prominent) the *jugulodigastric lymph nodes* (Fig. 20.20).
- Clean away fat and connective tissue around the common carotid artery and medial to the carotid sheath and identify the superior thyroid artery (Fig. 20.21). This artery runs between the thyrohyoid muscle and the carotid sheath. Do not try to identify the origin of this artery yet.
- Remove the jugulodigastric lymph nodes, and by pulling the parotid gland laterally, expose the posterior belly of the digastric muscle (Fig. 20.22).
- Expose the digastric muscle, with its posterior and anterior bellies, and the stylohyoid muscle.
- Observe the tendon insertion of the stylohyoid muscle onto the hyoid and its relationship with the posterior belly of the digastric muscle.

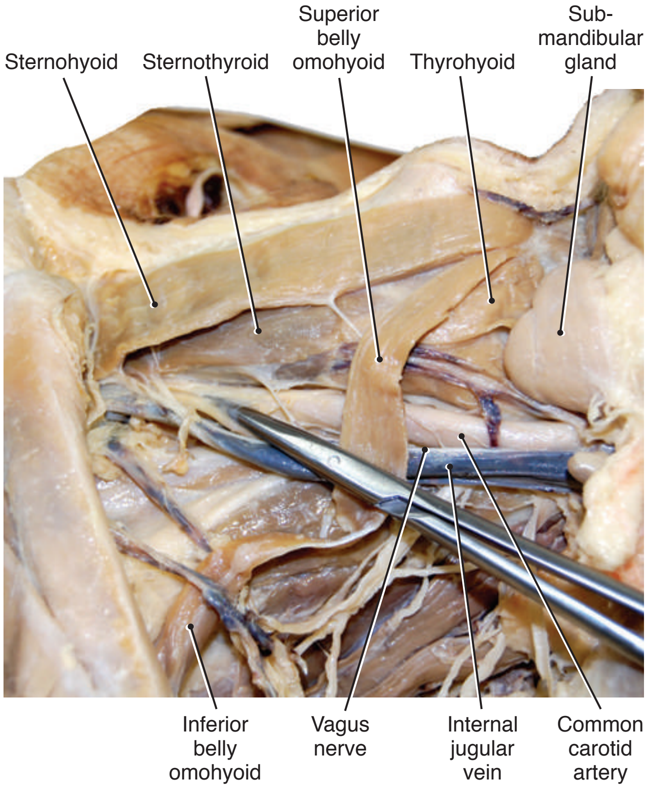
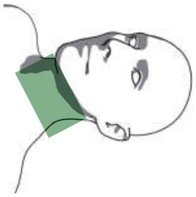

Sternohyoid
Sternothyroid
Superior belly omohyoid
Thyrohyoid
Sub-mandibular gland
Inferior belly omohyoid
Vagus nerve
Internal jugular vein
Common carotid artery

Fig. 20.19 Carotid sheath cleaned inferiorly, revealing vagus nerve and carotid artery toward root of neck.



- Identify the hyoid bone, and expose the mylohyoid muscle, which is partially hidden by the anterior belly of the digastric muscle (see Fig. 20.22).
- Expose the distal portion of the common carotid artery at its division into the internal and external carotid arteries (Fig. 20.23).
- Identify the origin of the *superior thyroid artery* from the external carotid artery, and trace it to its termination in the thyroid gland.

DISSECTION **TIP**

To create more space for exposing the branches of the external carotid artery, detach the submandibular gland from its base (Fig. 20.24) and mobilize it medially.

- Dissect out the facial artery, which passes deep to the submandibular gland before emerging at the angle of the mandible (Fig. 20.25).
- Mobilize the submandibular gland medially, and expose the stylohyoid muscle and the posterior belly of the digastric muscle. Identify the hypoglossal nerve running parallel to the digastric posterior belly (Fig. 20.26).

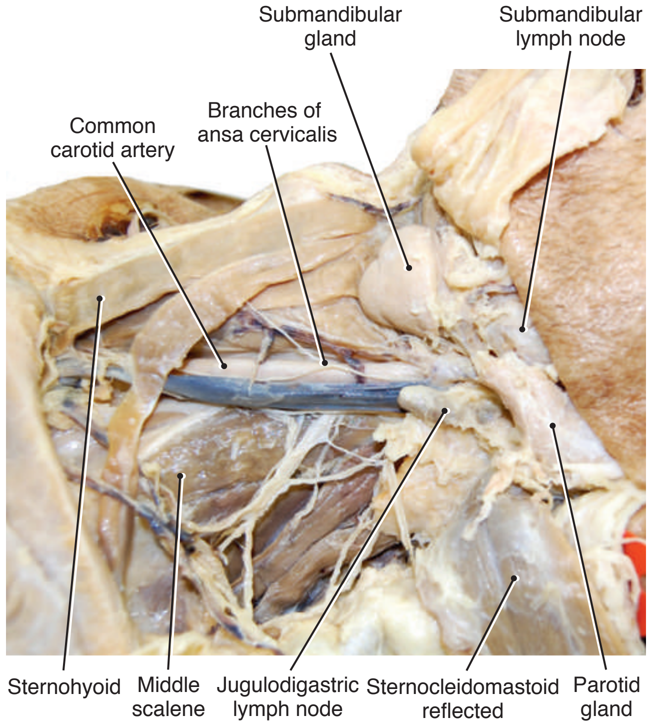
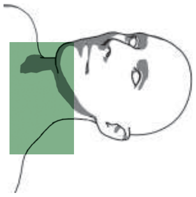

Submandibular gland
Submandibular lymph node
Common carotid artery
Branches of ansa cervicalis
Sternohyoid
Middle scalene
Jugulodigastric lymph node
Sternocleidomastoid reflected
Parotid gland

Fig. 20.20 Appreciate jugulodigastric lymph nodes and parotid and submandibular glands.



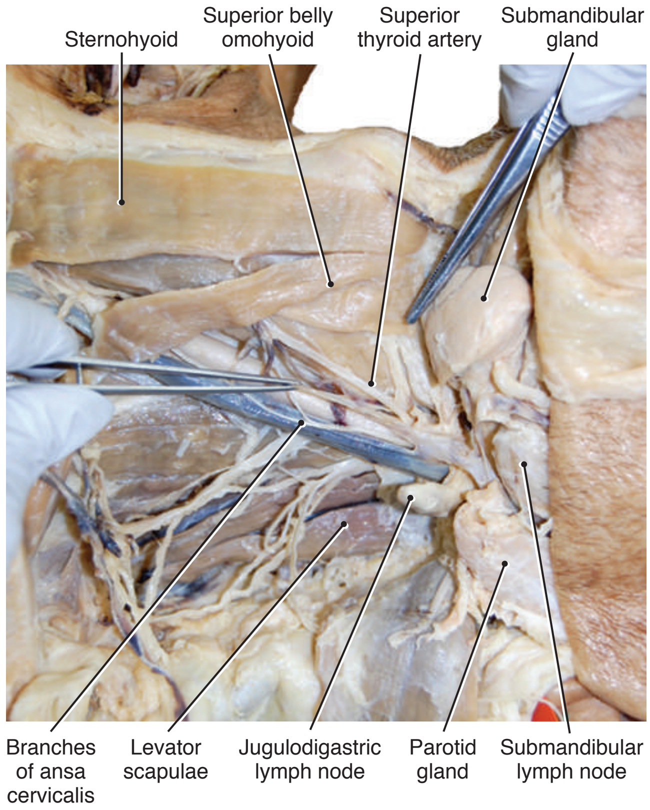
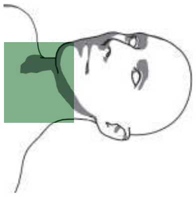

Sternohyoid
Superior belly omohyoid
Superior thyroid artery
Submandibular gland
Branches of ansa cervicalis
Levator scapulae
Jugulodigastric lymph node
Parotid gland
Submandibular lymph node

Fig. 20.21 Fat and connective tissue removed around common carotid artery and medial to carotid sheath to highlight superior thyroid artery.



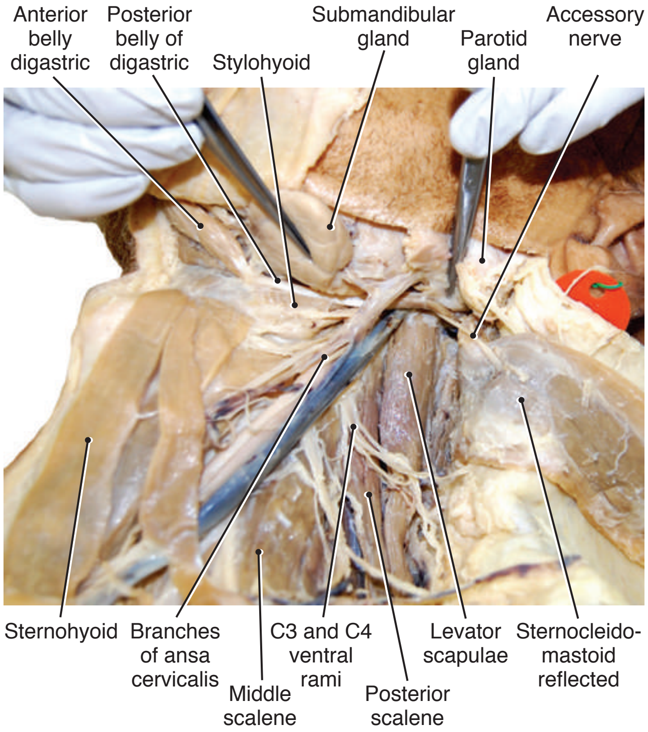

Anterior belly digastric
Posterior belly of digastric
Stylohyoid
Submandibular gland
Parotid gland
Accessory nerve
Sternohyoid
Branches of ansa cervicalis
Middle scalene
C3 and C4 ventral rami
Posterior scalene
Levator scapulae
Sternocleido-mastoid reflected

Fig. 20.22 Submandibular and parotid glands lifted to expose external and internal carotid arteries.

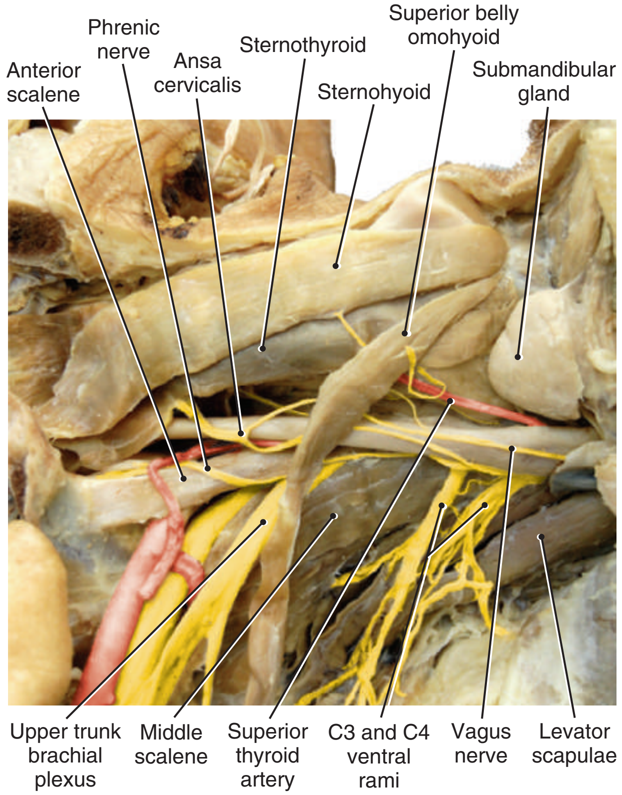
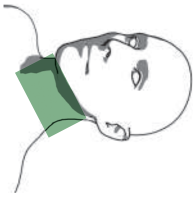

Anterior scalene
Phrenic nerve
Ansa cervicalis
Sternothyroid
Sternohyoid
Superior belly omohyoid
Submandibular gland
Upper trunk brachial plexus
Middle scalene
Superior thyroid artery
C3 and C4 ventral rami
Vagus nerve
Levator scapulae

Fig. 20.23 Anterolateral view of neck revealing neurovascular structures of anterior and posterior cervical triangles.



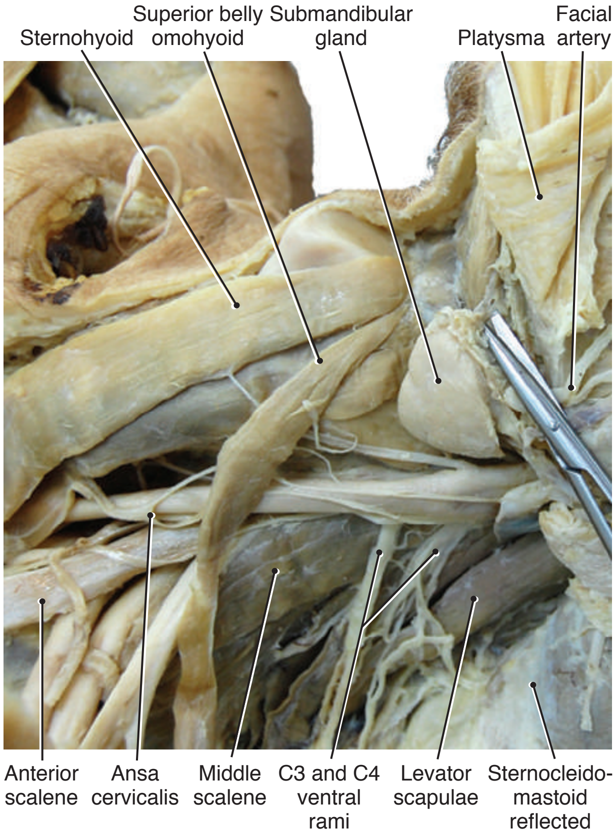
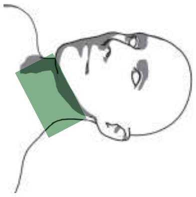

Sternohyoid
Superior belly omohyoid
Submandibular gland
Platysma
Facial artery
Anterior scalene
Ansa cervicalis
Middle scalene
C3 and C4 ventral rami
Levator scapulae
Sternocleido-mastoid reflected

Fig. 20.24 Submandibular gland detached from base to create more space for exposing branches of the external carotid artery.



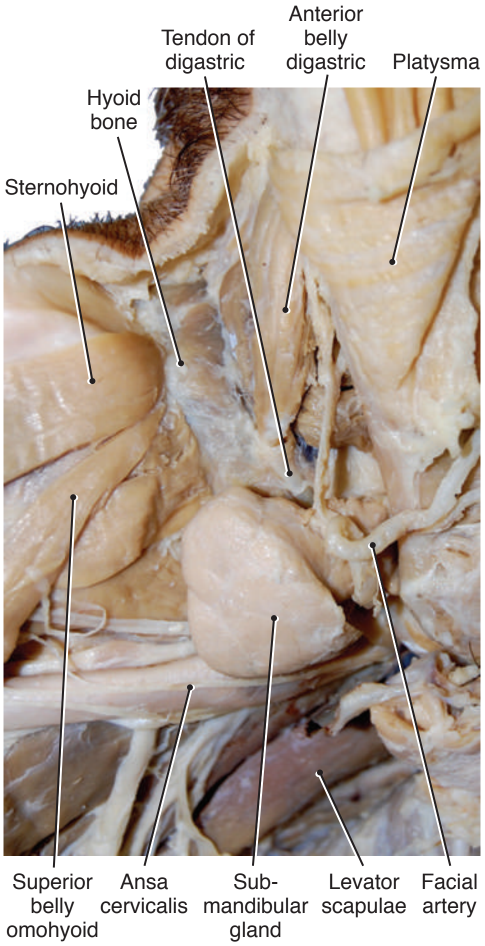
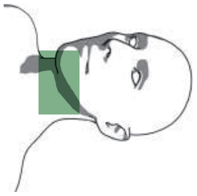

Tendon of digastric
Anterior belly digastric
Platysma
Hyoid bone
Sternohyoid
Superior belly omohyoid
Ansa cervicalis
Sub-mandibular gland
Levator scapulae
Facial artery

Fig. 20.25 Dissection of facial artery, which passes deep to submandibular gland before emerging at the angle of mandible.



- Note the small branch of the superior thyroid artery, the *superior laryngeal artery,* which travels medially and penetrates the thyrohyoid membrane (Fig. 20.27).

ANATOMY **NOTE**

The superior laryngeal artery has a variable origin. If it does not arise from the superior thyroid artery, the superior laryngeal may arise directly from the external carotid artery.

- Parallel to the superior laryngeal artery, expose the internal branch of the superior laryngeal nerve, which also penetrates the thyrohyoid membrane.
- Observe the superior root of the ansa cervicalis all the way to the hypoglossal nerve. Note that the ansa cervicalis travels within the connective tissue sheath of the hypoglossal nerve.
- At the origin of the internal carotid artery, look for a dilation of its wall, the *carotid sinus* (Fig. 20.28).

ANATOMY **NOTE**

The carotid sinus contains nerve fibers responsible for detecting blood pressure changes at this location.

- Using scissors, expose the division of the common carotid artery, and identify the *carotid body* (Fig. 20.29), a small mass of specialized cells that act as chemoreceptors (Plate 20.2).

ANATOMY **NOTE**

A branch of the glossopharyngeal nerve (carotid sinus nerve, or Hering's nerve) is responsible for the nerve supply to the carotid body and sinus.

- Pull the common carotid artery laterally (Fig. 20.30), and expose the *lingual artery*.

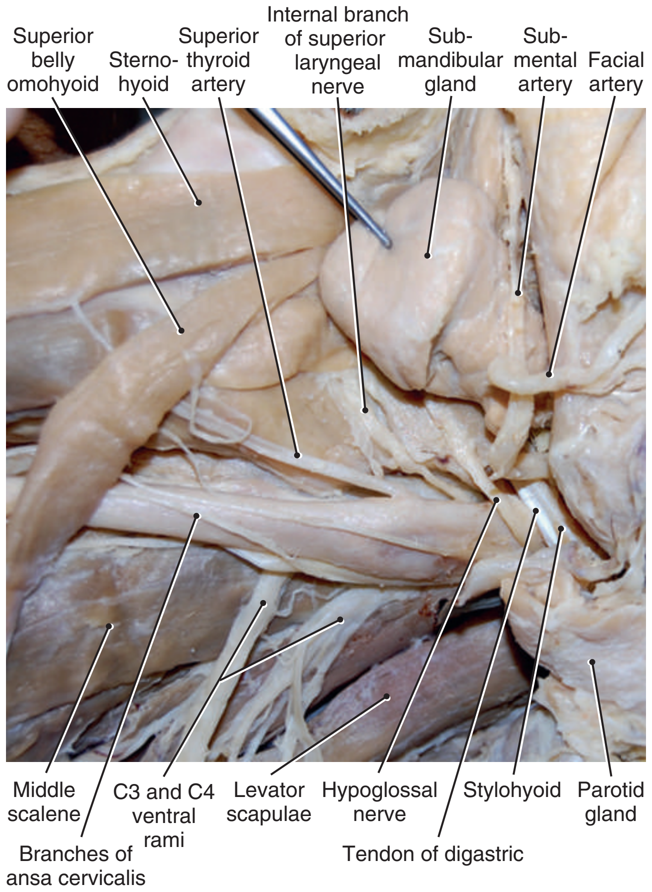
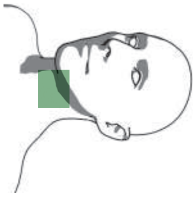

Superior belly omohyoid
Sterno-hyoid
Superior thyroid artery
Internal branch of superior laryngeal nerve
Sub-mandibular gland
Sub-mental artery
Facial artery
Middle scalene
Branches of ansa cervicalis
C3 and C4 ventral rami
Levator scapulae
Hypoglossal nerve
Tendon of digastric
Stylohyoid
Parotid gland

Fig. 20.26 Submandibular gland lifted to expose internal laryngeal and hypoglossal nerves, posterior belly of digastric muscle, and facial artery.



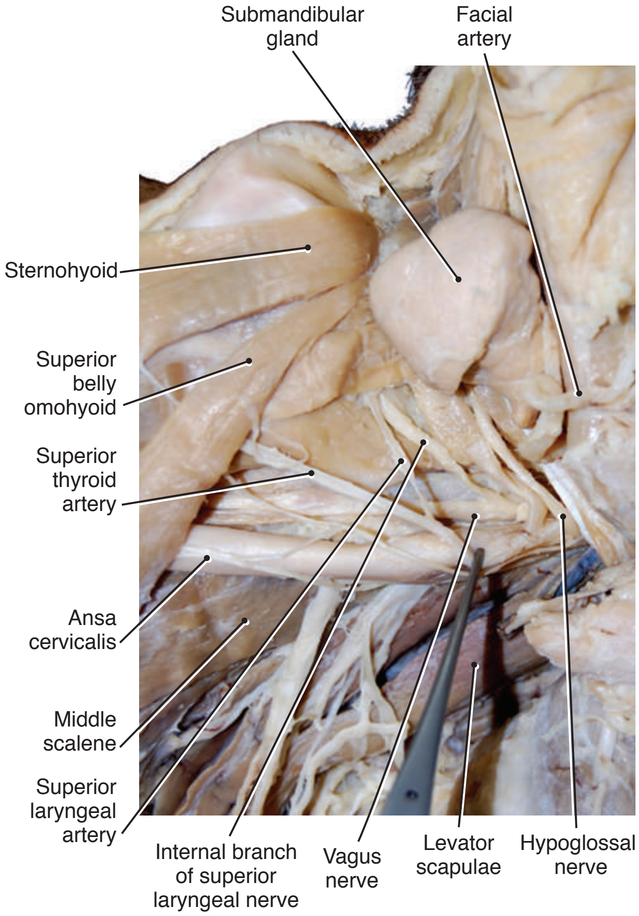
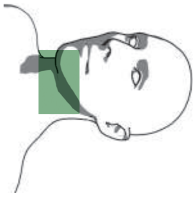

Submandibular gland
Facial artery
Sternohyoid
Superior belly omohyoid
Superior thyroid artery
Ansa cervicalis
Middle scalene
Superior laryngeal artery
Internal branch of superior laryngeal nerve
Vagus nerve
Levator scapulae
Hypoglossal nerve

Fig. 20.27 Anterolateral view of neck.



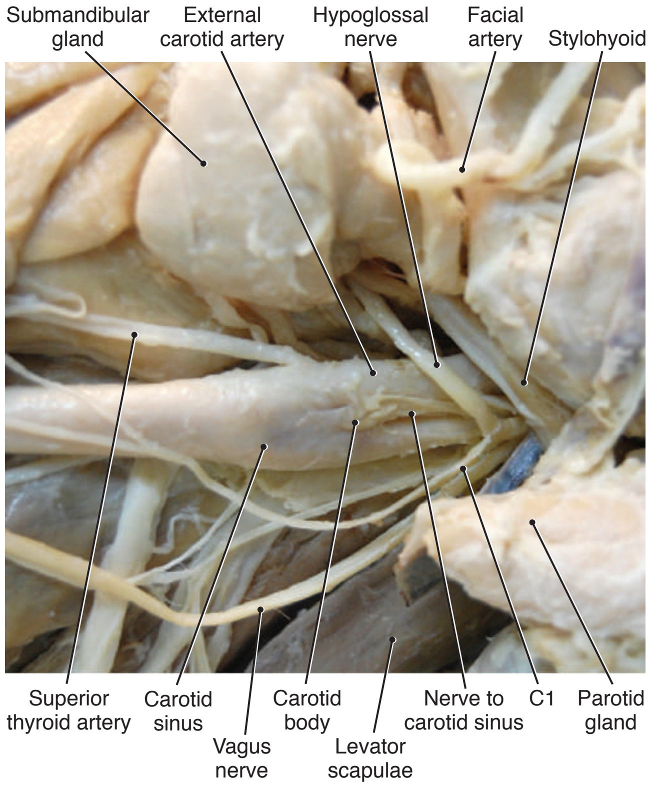
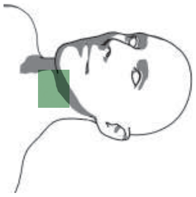

Submandibular gland
External carotid artery
Hypoglossal nerve
Facial artery
Stylohyoid
Superior thyroid artery
Carotid sinus
Vagus nerve
Carotid body
Levator scapulae
Nerve to carotid sinus
C1
Parotid gland

Fig. 20.28 Anterolateral close-up view of neck in region of carotid artery bifurcation.



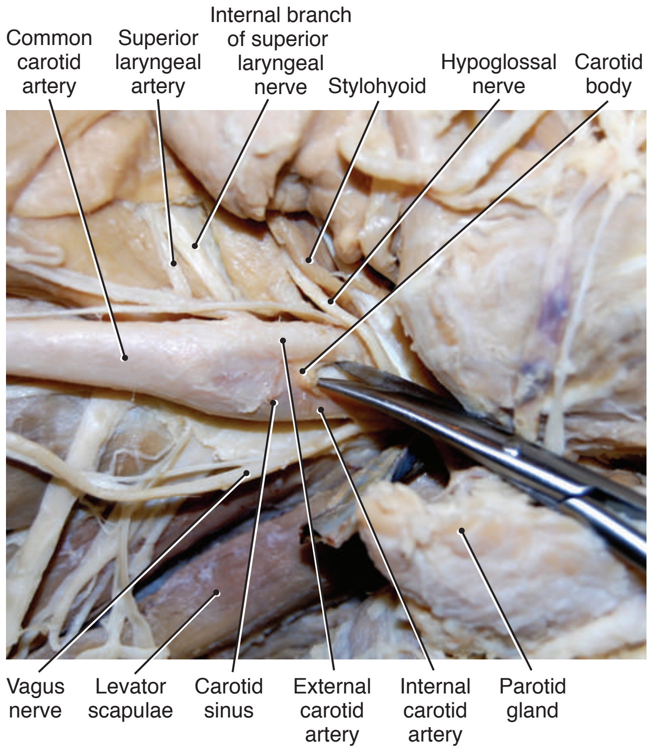
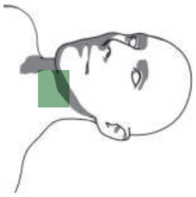

Common carotid artery
Superior laryngeal artery
Internal branch of superior laryngeal nerve
Stylohyoid
Hypoglossal nerve
Carotid body
Vagus nerve
Levator scapulae
Carotid sinus
External carotid artery
Internal carotid artery
Parotid gland

Fig. 20.29 Anterolateral close-up view of neck in region of carotid artery bifurcation.



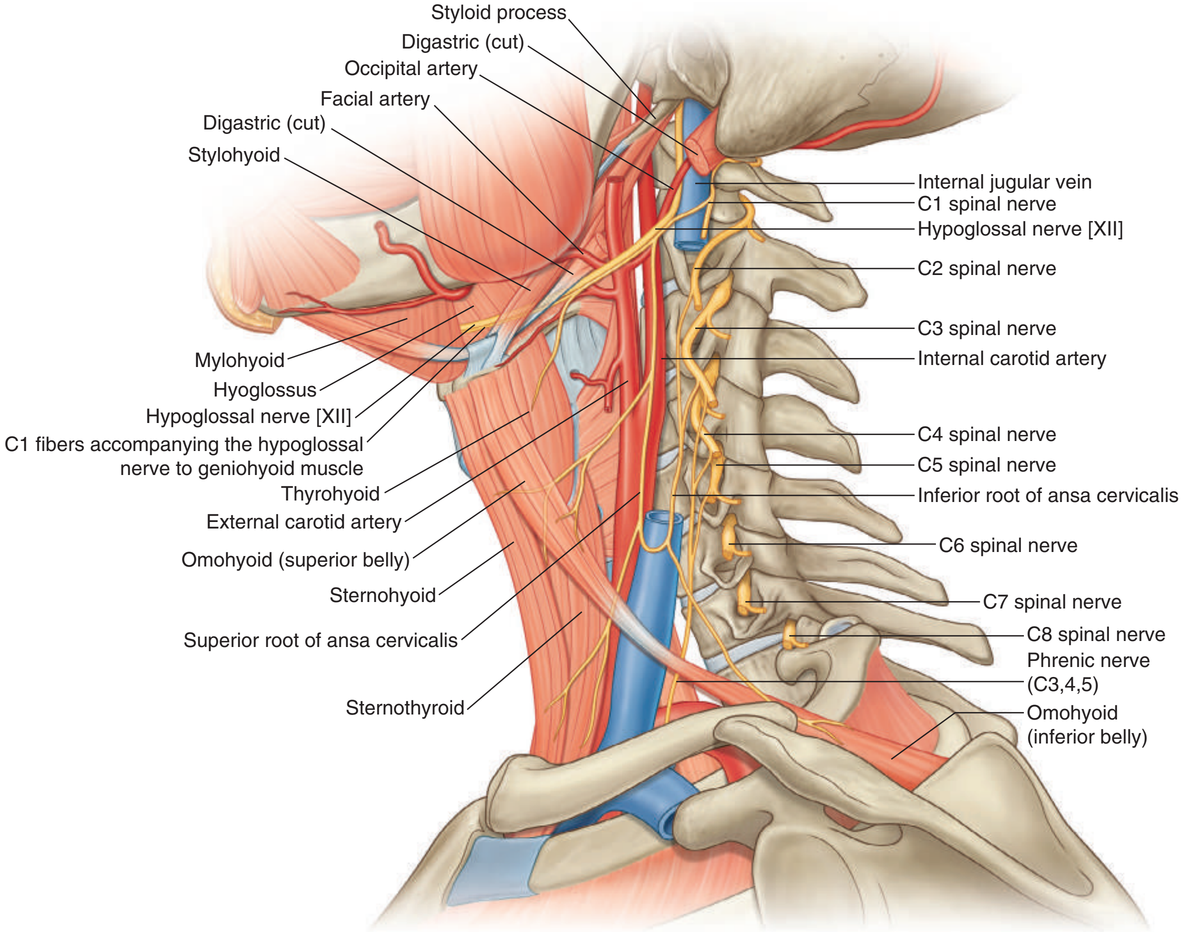

Styloid process
Digastric (cut)
Occipital artery
Facial artery
Digastric (cut)
Stylohyoid
Mylohyoid
Hyoglossus
Hypoglossal nerve [XII]
C1 fibers accompanying the hypoglossal nerve to geniohyoid muscle
Thyrohyoid
External carotid artery
Omohyoid (superior belly)
Sternohyoid
Superior root of ansa cervicalis
Sternothyroid
Internal jugular vein
C1 spinal nerve
Hypoglossal nerve [XII]
C2 spinal nerve
C3 spinal nerve
Internal carotid artery
C4 spinal nerve
C5 spinal nerve
Inferior root of ansa cervicalis
C6 spinal nerve
C7 spinal nerve
C8 spinal nerve
Phrenic nerve (C3,4,5)
Omohyoid (inferior belly)

Plate 20.2 Lateral view of the neck exposing cervical spinal nerves, ansa cervicalis, and hypoglossal nerve.

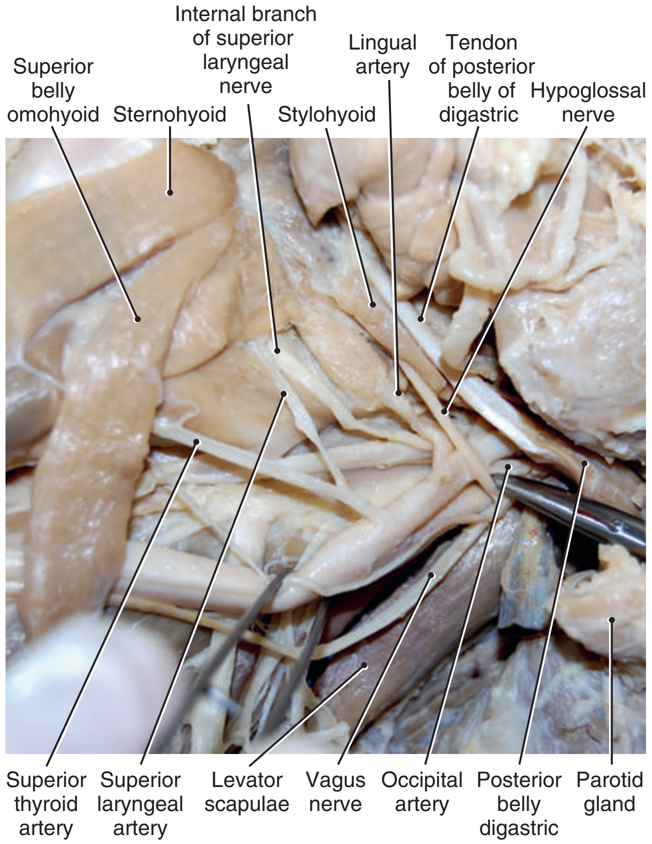
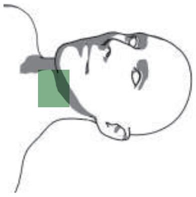

Superior belly omohyoid
Sternohyoid
Internal branch of superior laryngeal nerve
Stylohyoid
Lingual artery
Tendon of posterior belly of digastric
Hypoglossal nerve
Superior thyroid artery
Superior laryngeal artery
Levator scapulae
Vagus nerve
Occipital artery
Posterior belly digastric
Parotid gland

Fig. 20.30 Anterolateral view of neck with skin, tela subcutanea, sternocleidomastoid reflected laterally and platysma reflected superiorly. Common carotid artery pulled laterally to reveal nerves and arteries.



ANATOMY **NOTE**

The lingual artery is commonly the second branch of the external carotid artery in the majority of cases.

- **If time permits, trace the lingual artery to the point where it passes deep to the hyoglossus muscle.**
- **At the lateral border of the external carotid artery, expose the *occipital artery*, which passes posteriorly, crossing over the hypoglossal nerve (see Fig. 20.30 and Plate 20.2).**

ANATOMY **NOTE**

In the majority of cases, the occipital artery gives rise to the artery of the sternocleidomastoid muscle.

- **Opposite the occipital artery, at the medial border of the external carotid artery and superior to the lingual artery, identify the *facial artery,* and trace it to the submandibular gland at the angle of the mandible (Fig. 20.31).**

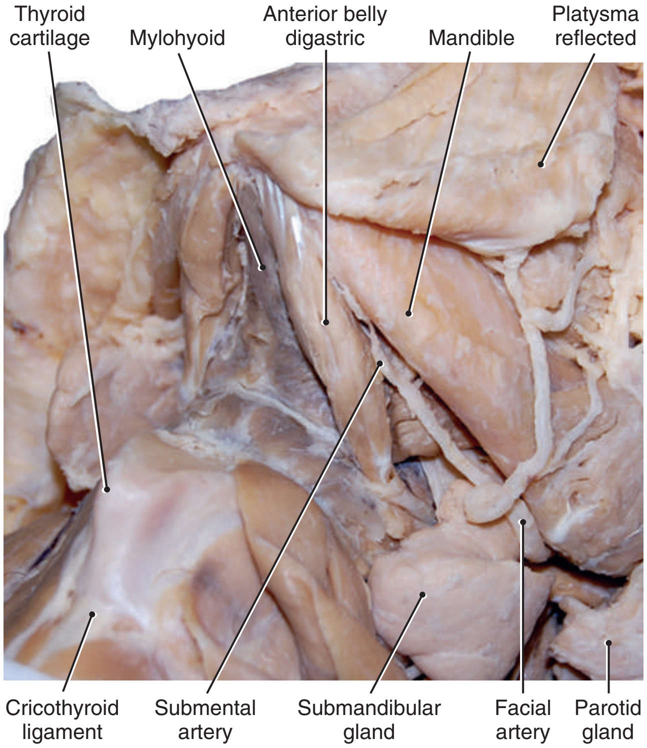

Thyroid cartilage
Mylohyoid
Anterior belly digastric
Mandible
Platysma reflected
Cricothyroid ligament
Submental artery
Submandibular gland
Facial artery
Parotid gland

Fig. 20.31 Anteroinferior view of midline of neck with skin, tela subcutanea, and platysma reflected.

ANATOMY **NOTE**

In some cadavers the facial and lingual arteries may have a common origin, the *faciolingual trunk.* Similarly, the lingual and the superior thyroid arteries may originate as a common trunk.

- **Posterior to the origin of the external carotid artery, identify the ascending pharyngeal artery, which travels between the internal carotid and the lateral aspect of the pharynx.**
- **Clean any muscle attachments and connective tissue from the clavicle to expose the *brachial plexus* in the supraclavicular area (Fig. 20.32).**
- **Cover the neck and thorax with paper towels to protect the dissected structures from bone dust (Fig. 20.33).**
- **With an electric saw, cut the clavicle at the jugular notch and at its distal one third (Fig. 20.34).**
- **With scissors, detach the clavicle from the underlying connective tissue and subclavius muscle (Figs. 20.35 and 20.36).**
- **Reflect the subclavius muscle laterally, and expose the root of the neck and the brachial plexus (Fig. 20.37).**
- **Identify the anterior scalene muscle (Fig. 20.38), and on its surface identify the phrenic nerve (Fig. 20.39).**

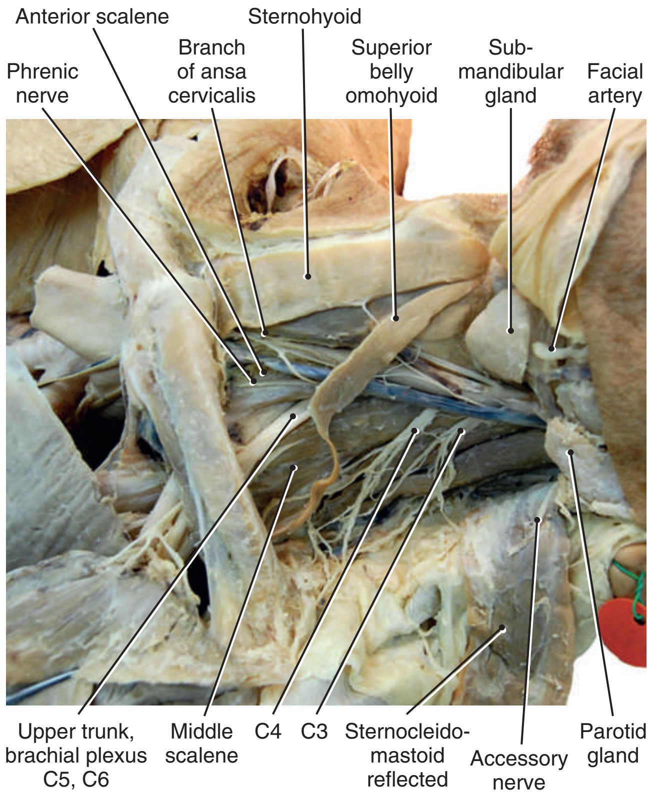
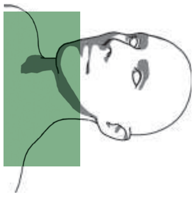

Anterior scalene
Sternohyoid
Phrenic nerve
Branch of ansa cervicalis
Superior belly omohyoid
Sub-mandibular gland
Facial artery
Upper trunk, brachial plexus C5, C6
Middle scalene
C4
C3
Sternocleido-mastoid reflected
Accessory nerve
Parotid gland

Fig. 20.32 Cleaned clavicle and adipose tissue removed, further revealing key neurovascular structures.



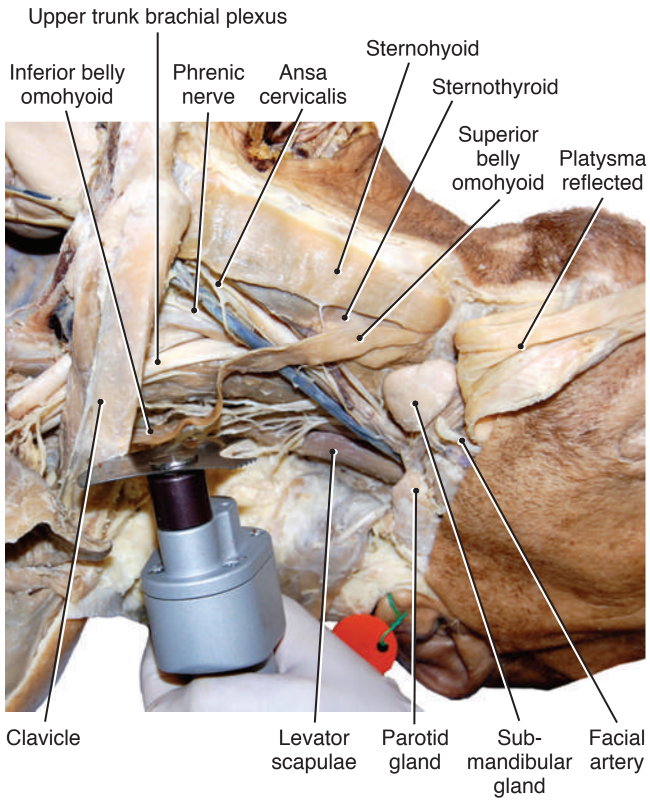
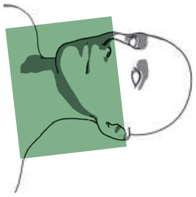

Upper trunk brachial plexus
Sternohyoid
Inferior belly omohyoid
Phrenic nerve
Ansa cervicalis
Sternothyroid
Superior belly omohyoid
Platysma reflected
Clavicle
Levator scapulae
Parotid gland
Sub-mandibular gland
Facial artery

Fig. 20.34 Clavicle cut at jugular notch and its distal one third.



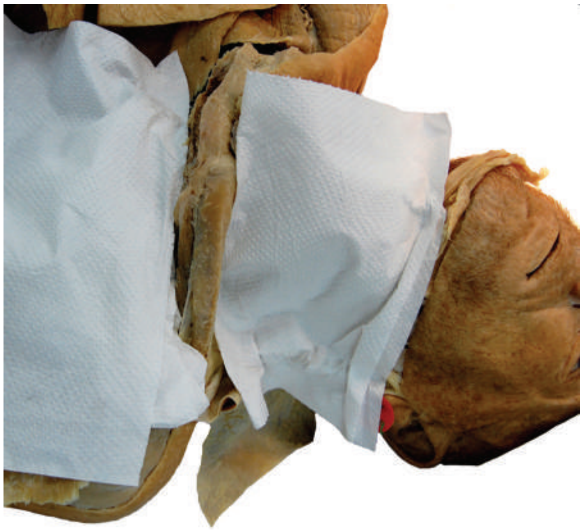


Fig. 20.33 Neck and thorax covered with paper towels to protect the dissected structures from bone dust when using a bone saw.

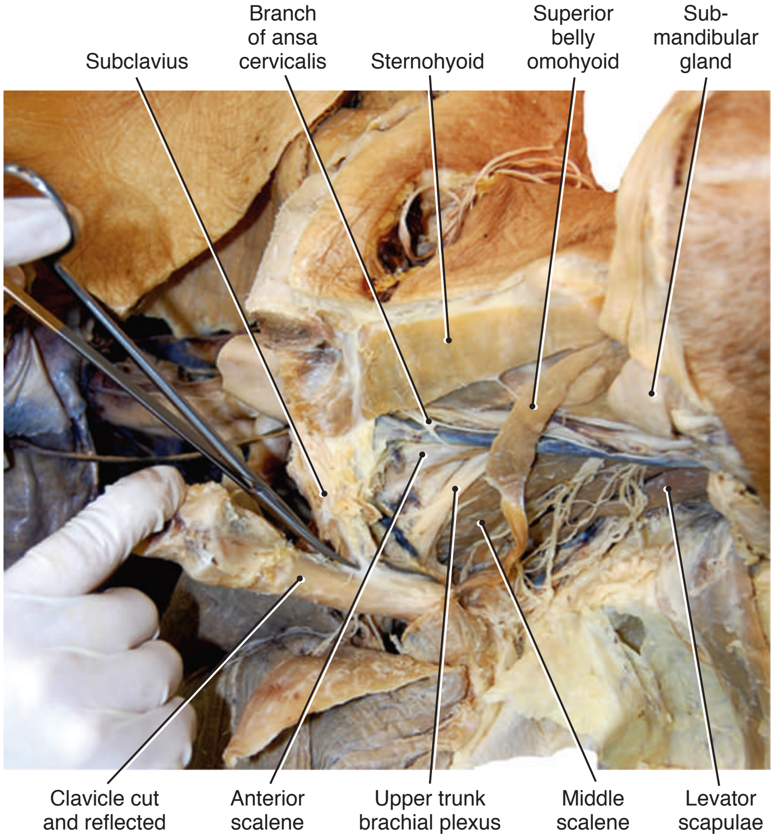
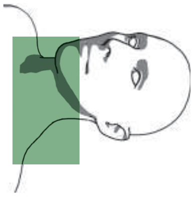

Subclavius
Branch of ansa cervicalis
Sternohyoid
Superior belly omohyoid
Sub-mandibular gland
Clavicle cut and reflected
Anterior scalene
Upper trunk brachial plexus
Middle scalene
Levator scapulae

Fig. 20.35 Clavicle detached from underlying connective tissue and subclavius muscle.



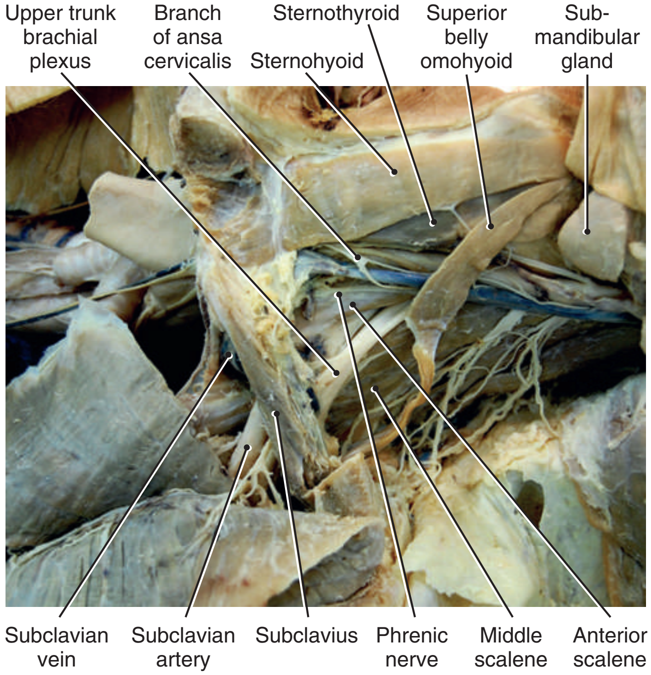
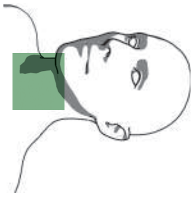

Upper trunk brachial plexus
Branch of ansa cervicalis
Sternohyoid
Sternothyroid
Superior belly omohyoid
Sub-mandibular gland
Subclavian vein
Subclavian artery
Subclavius
Phrenic nerve
Middle scalene
Anterior scalene

Fig. 20.36 Appreciate subclavius muscle and brachial plexus at root of neck.



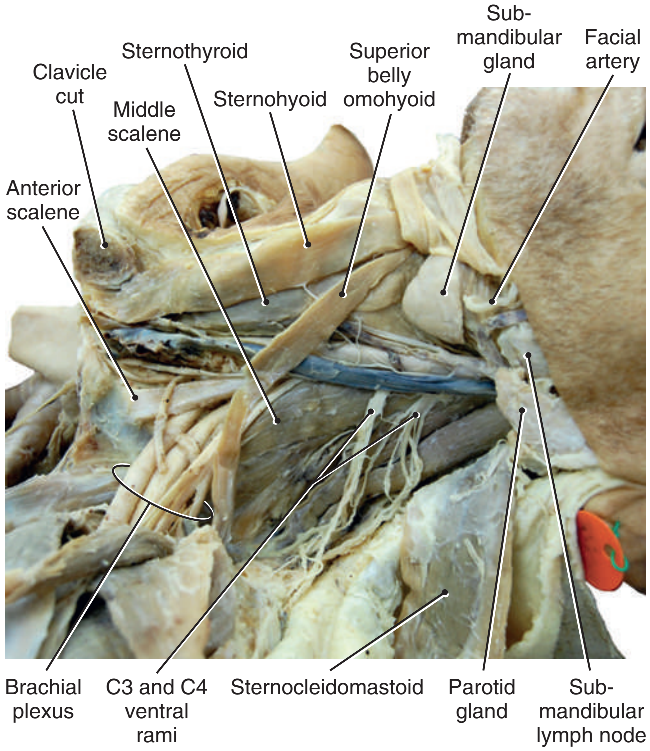
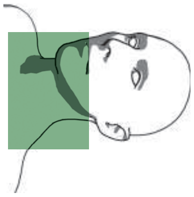
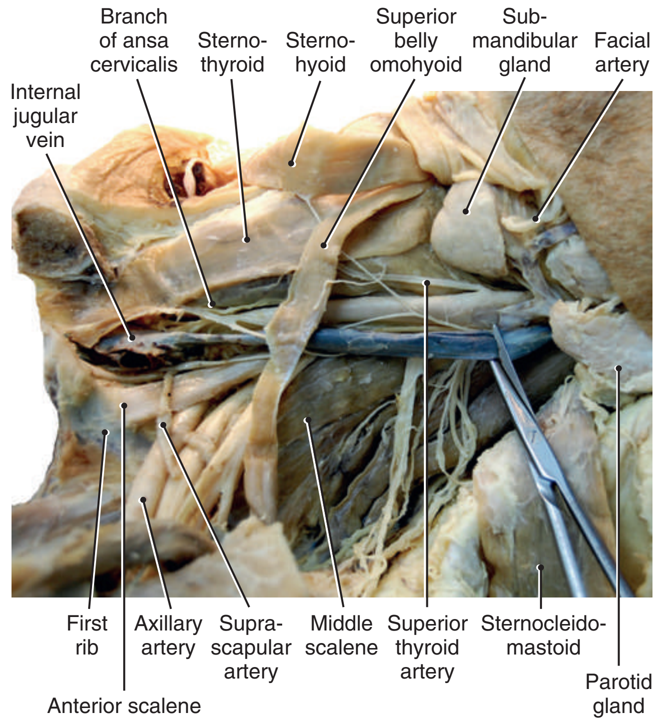

Clavicle cut
Anterior scalene
Middle scalene
Sternothyroid
Sternohyoid
Superior belly omohyoid
Sub-mandibular gland
Facial artery
Brachial plexus
C3 and C4 ventral rami
Sternocleidomastoid
Parotid gland
Sub-mandibular lymph node

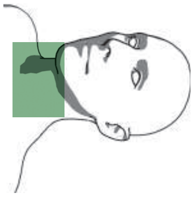
Fig. 20.37 Subclavius muscle reflected laterally to expose root of neck.

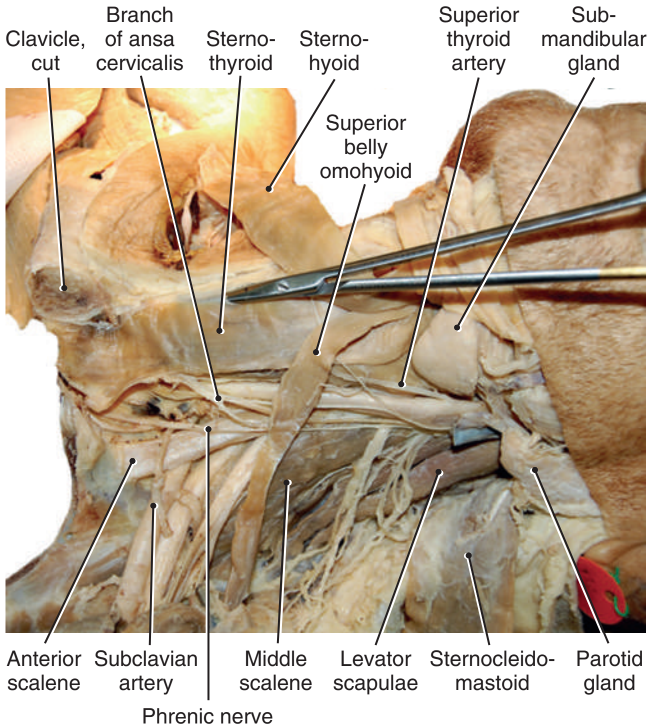




Branch of ansa cervicalis
Sterno-thyroid
Sterno-hyoid
Superior belly omohyoid
Sub-mandibular gland
Facial artery
Internal jugular vein
First rib
Axillary artery
Supra-scapular artery
Middle scalene
Superior thyroid artery
Sternocleido-mastoid
Parotid gland
Anterior scalene

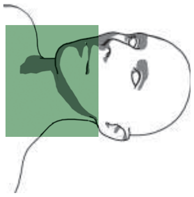
Fig. 20.38 Internal jugular vein incised at level of bifurcation of common carotid artery and removed from the neck.

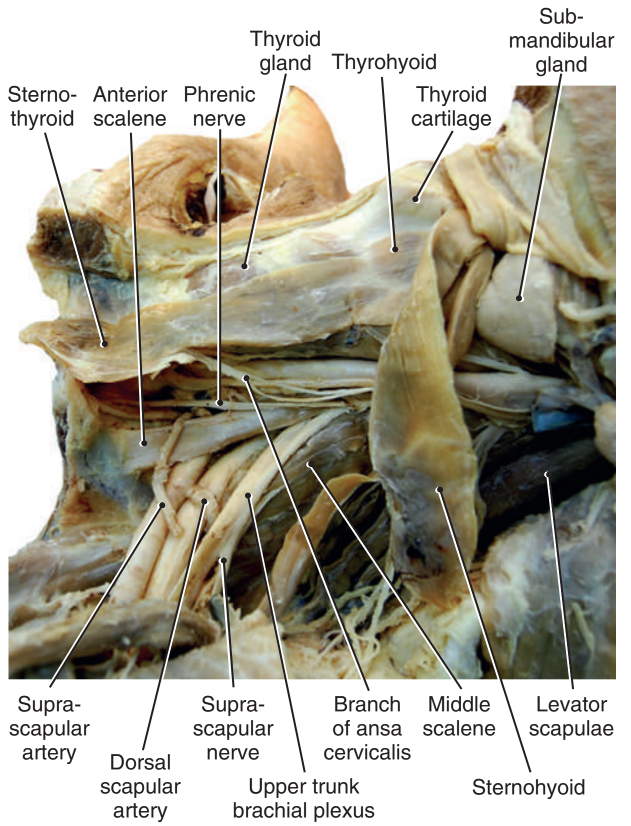




Clavicle, cut
Branch of ansa cervicalis
Sterno-thyroid
Sterno-hyoid
Superior thyroid artery
Sub-mandibular gland
Superior belly omohyoid
Anterior scalene
Subclavian artery
Middle scalene
Levator scapulae
Sternocleido-mastoid
Parotid gland
Phrenic nerve

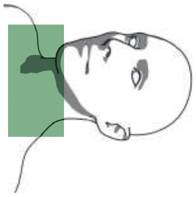
Fig. 20.39 Appreciate the course of the phrenic nerve in the neck.





Thyroid gland
Thyrohyoid
Sub-mandibular gland
Sterno-thyroid
Anterior scalene
Phrenic nerve
Thyroid cartilage
Supra-scapular artery
Dorsal scapular artery
Supra-scapular nerve
Upper trunk brachial plexus
Branch of ansa cervicalis
Middle scalene
Levator scapulae
Sternohyoid

Fig. 20.40 Appreciate supraclavicular nerves and phrenic nerve crossed by branches of thyrocervical trunk.



- With scissors, cut the internal jugular vein at the level of the bifurcation of the common carotid artery, and remove it from the neck.
- Trace the supraclavicular nerves, noting their origin from cervical nerves 3 and 4 (C3, C4) (see Fig. 20.39).
- On the anterior surface of the anterior scalene muscle, note the phrenic nerve is crossed by branches of the thyrocervical trunk, the transverse cervical and suprascapular arteries (Fig. 20.40).
- Cut the inferior attachments of the sternohyoid and sternothyroid muscles, and reflect them upward to expose the *thyroid gland* (Figs. 20.41 and 20.42).
- Notice the branches from the ansa cervicalis innervating the strap muscles.
- Follow the superior thyroid artery medial to its termination into the thyroid gland. Identify the cricothyroid muscle superior to the thyroid gland (see Fig. 20.40).
- Note the two lobes of the thyroid gland connected by the isthmus.

ANATOMY **NOTE**

A pyramidal lobe may be present, traveling from the thyroid gland toward the hyoid bone.

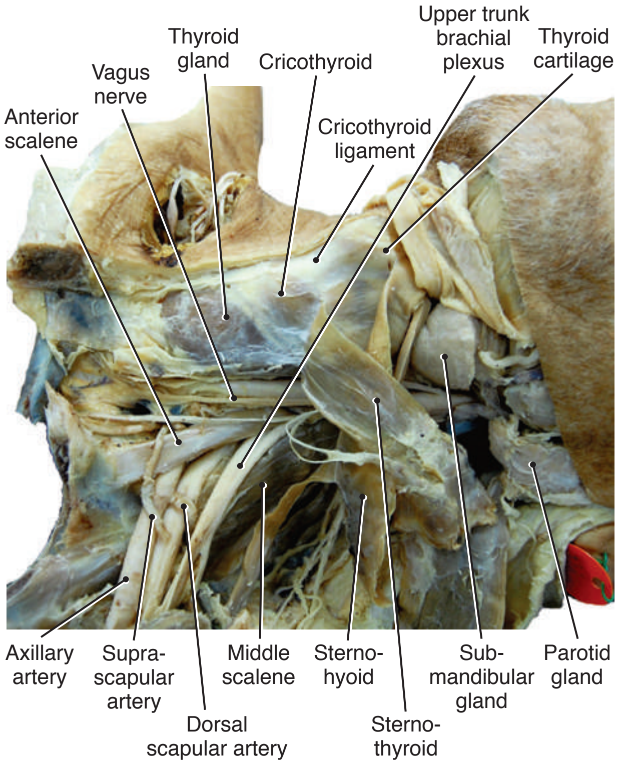
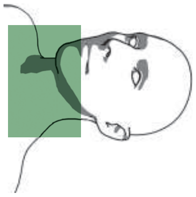

Anterior scalene
Vagus nerve
Thyroid gland
Cricothyroid
Cricothyroid ligament
Upper trunk brachial plexus
Thyroid cartilage
Axillary artery
Suprascapular artery
Dorsal scapular artery
Middle scalene
Sternohyoid
Sternothyroid
Submandibular gland
Parotid gland

Fig. 20.41 Inferior attachments of sternohyoid and sternothyroid muscles reflected upward to expose thyroid gland.



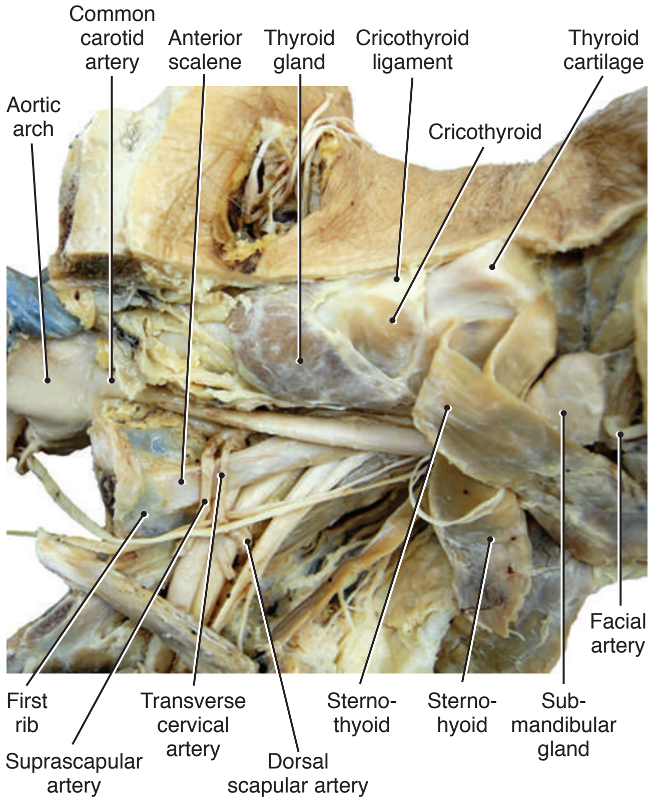
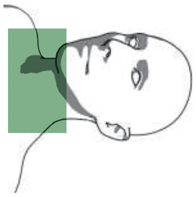

Common carotid artery
Aortic arch
Anterior scalene
Thyroid gland
Cricothyroid ligament
Cricothyroid
Thyroid cartilage
Facial artery
First rib
Suprascapular artery
Transverse cervical artery
Dorsal scapular artery
Sterno-thyoid
Sternohyoid
Submandibular gland

Fig. 20.42 Thyroid gland and cricothyroid muscle exposed.



- If time permits, cut the isthmus of the thyroid gland, and reflect the gland laterally from the trachea.
- Look on the posterior surface of the thyroid gland for the *parathyroid glands,* typically found close to the posterior branches of the superior and inferior thyroid arteries.
- If time permits, identify the superior and middle thyroid veins, and trace them back to the internal jugular vein.
- Pull the common carotid artery laterally, and trace the superior thyroid artery (Fig. 20.43).
- Locate the internal laryngeal branch of the superior laryngeal nerve, and trace its origin back to the superior laryngeal nerve.
- Pull the internal laryngeal nerve away from its origin, and identify the external laryngeal branch. Follow this nerve as it descends into the neck medial to the common carotid artery, running along the superior thyroid artery.
- Clean the superior thyroid artery, and find the external laryngeal nerve piercing the cricothyroid muscle.
- Pull the common carotid artery laterally to expose the space between the anterior scalene muscle and trachea (Fig. 20.44).
- Clean the connective tissue in this space, and identify the inferior thyroid artery, thyrocervical trunk, and recurrent laryngeal nerve (Fig. 20.45).

ANATOMY **NOTE**

The *inferior thyroid artery* is a branch of the thyrocervical trunk that supplies the inferior pole of the thyroid gland.

- Dissect the fat and connective tissue medial to the trachea (tracheoesophageal groove), and identify the *recurrent laryngeal nerve* (Fig. 20.46).

ANATOMY **NOTE**

The left recurrent laryngeal nerve arises from the left vagus nerve in the thorax as the vagus nerve crosses the arch of the aorta. The right recurrent laryngeal nerve arises from the right vagus nerve as it crosses the right subclavian artery.

ANATOMY **NOTE**

The *inferior thyroid artery* crosses the recurrent laryngeal nerve at the inferior pole of the thyroid artery (Fig. 20.47). This is an important surgical landmark.

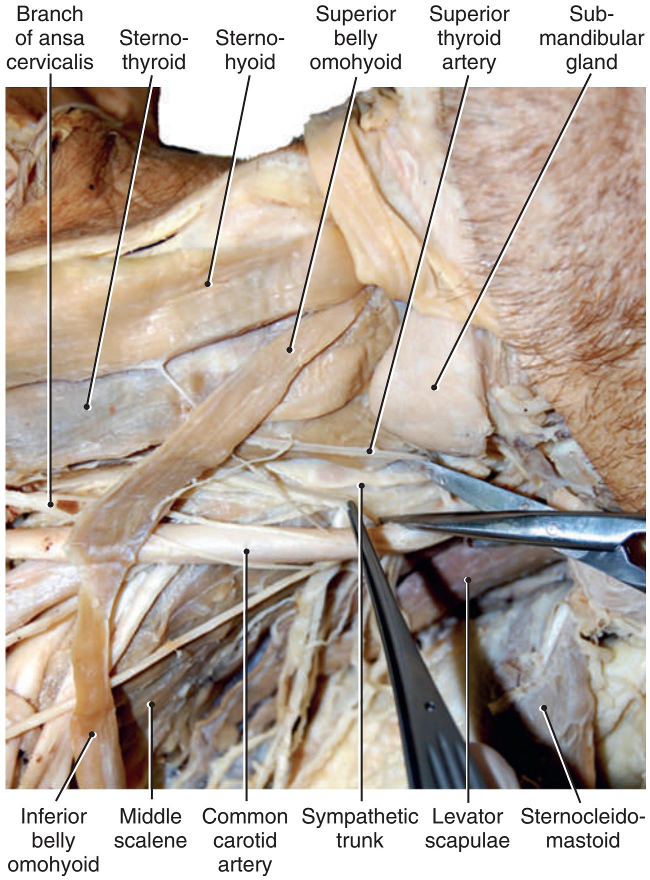
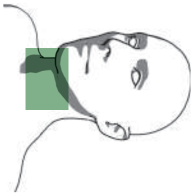

Branch of ansa cervicalis
Sterno-thyroid
Sterno-hyoid
Superior belly omohyoid
Superior thyroid artery
Sub-mandibular gland
Inferior belly omohyoid
Middle scalene
Common carotid artery
Sympathetic trunk
Levator scapulae
Sternocleido-mastoid

Fig. 20.43 Common carotid artery pulled laterally to trace superior thyroid artery, internal laryngeal nerve, superior laryngeal artery, and external laryngeal nerve.



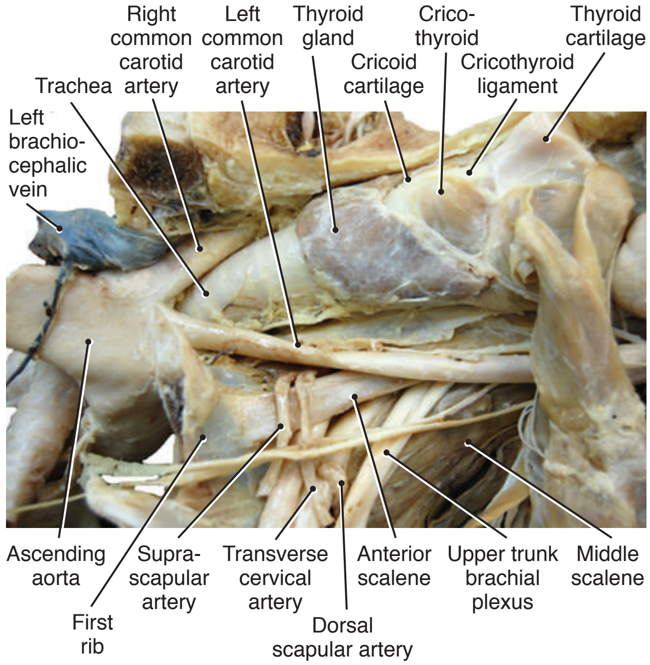
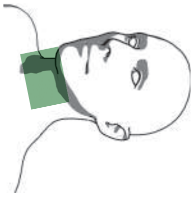

Right common carotid artery
Left common carotid artery
Thyroid gland
Crico-thyroid
Thyroid cartilage
Trachea
Cricoid cartilage
Cricothyroid ligament
Left brachio-cephalic vein
Ascending aorta
Supra-scapular artery
Transverse cervical artery
Anterior scalene
Upper trunk brachial plexus
Middle scalene
First rib
Dorsal scapular artery

Fig. 20.44 Appreciate the common carotid artery in the tracheoesophageal region, with recurrent laryngeal nerve along the tracheoesophageal groove.



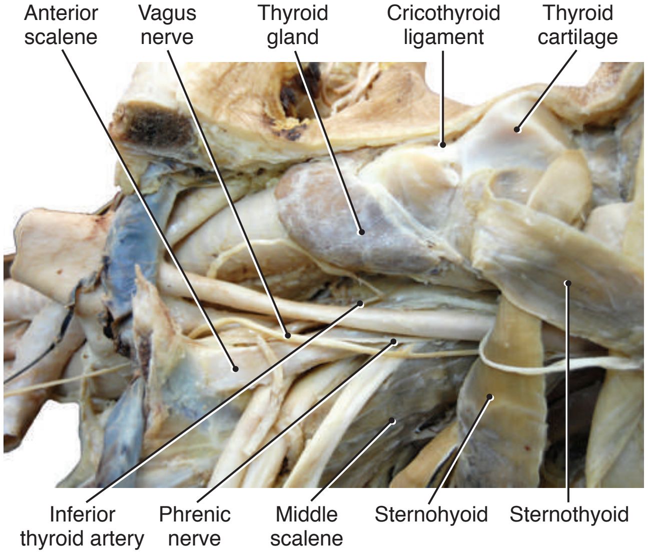
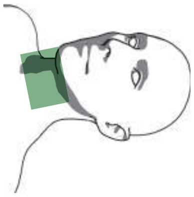

Anterior scalene
Vagus nerve
Thyroid gland
Cricothyroid ligament
Thyroid cartilage
Inferior thyroid artery
Phrenic nerve
Middle scalene
Sternohyoid
Sternothyoid

Fig. 20.45 Appreciate the inferior thyroid artery, a key surgical landmark.



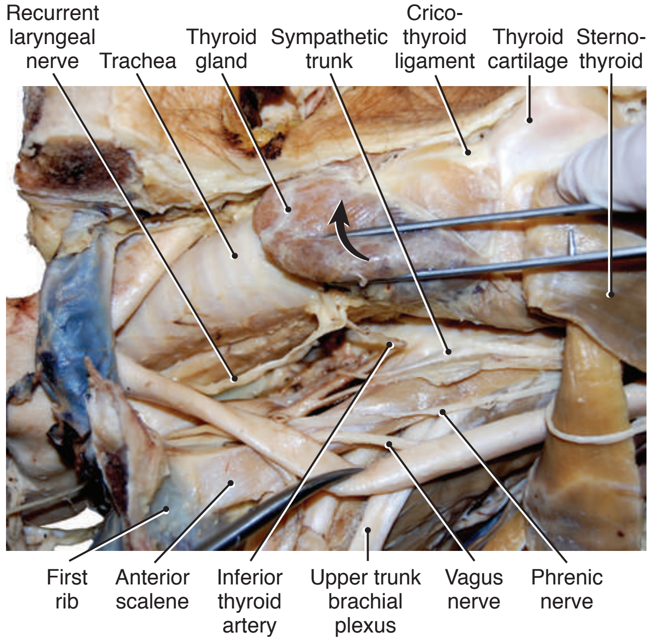
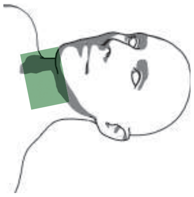

Recurrent laryngeal nerve
Trachea
Thyroid gland
Sympathetic trunk
Crico-thyroid ligament
Thyroid cartilage
Sterno-thyroid
First rib
Anterior scalene
Inferior thyroid artery
Upper trunk brachial plexus
Vagus nerve
Phrenic nerve

Fig. 20.46 Common carotid artery pulled laterally, revealing branches of thyrocervical trunk. Note the relationship between the recurrent laryngeal nerve and inferior thyroid artery.



ANATOMY **NOTE**

When the inferior thyroid artery arises from the aortic arch, brachiocephalic trunk, or common carotid or vertebral artery, it is called the *thyroidea ima* (lowest thyroid) artery. This variation is present in approximately 5% of the population.

ANATOMY **NOTE**

In some specimens a nonrecurrent laryngeal nerve is present. This variation is caused by a delay in the development of the aortic arches, resulting in the right vagus nerve giving off a transversely oriented, nonrecurrent laryngeal nerve, which passes directly toward the larynx without reaching the thorax. This anatomic situation is usually associated with a retroesophageal right subclavian artery.

- **Trace the previously identified transverse cervical and suprascapular arteries deep to their origin from the thyrocervical trunk (see Fig. 20.47).**

ANATOMY **NOTE**

The transverse cervical or suprascapular arteries may be absent. In such cases the dorsal scapular artery may be large and may arise from the subclavian artery, crossing over the first rib.

- **Lift the contents of the carotid sheath (internal jugular vein, common carotid artery, vagus nerve), and look posterior for the cervical part of the sympathetic trunk, or sympathetic trunk (see Fig. 20.50). Note that the sympathetic trunk and the roots of the cervical plexus lie behind the carotid sheath.**
- **The sympathetic trunk lies within a dense fascial layer, the prevertebral fascia. Clean the prevertebral fascia (and remnants of carotid sheath) posterior to the common carotid artery.**
- **Trace the sympathetic trunk inferiorly, and identify the superior, middle, and inferior cervical ganglia (see Fig. 20.53).**

DISSECTION **TIP**

The middle cervical ganglion is variable in origin and is often not present. The superior cervical ganglion can be identified at the level of the angle of the mandible. However, during the retropharyngeal dissection, it will be fully exposed.

- **Once the thyrocervical trunk is identified and its branches exposed, pull it laterally and look for the *vertebral artery*, which ascends medial and deep to it (see Figs. 20.47 and 20.48).**
- **Near the origin of the vertebral artery, identify the inferior cervical ganglion and/or the stellate ganglion (Figs. 20.49 and 20.50).**
- **The inferior cervical ganglion is large and often fused with the first thoracic trunk ganglion, forming the stellate (cervicothoracic) ganglion (Fig. 20.51).**

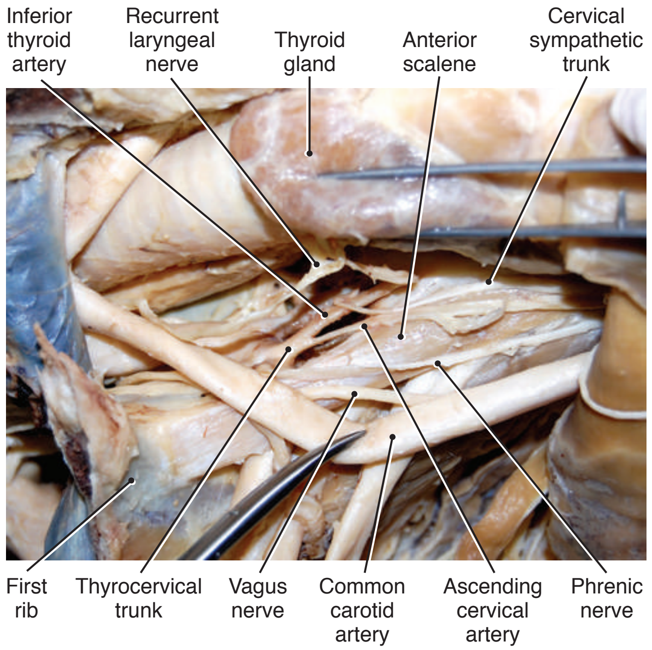
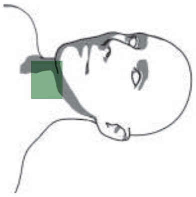

Inferior thyroid artery
Recurrent laryngeal nerve
Thyroid gland
Anterior scalene
Cervical sympathetic trunk
First rib
Thyrocervical trunk
Vagus nerve
Common carotid artery
Ascending cervical artery
Phrenic nerve

Fig. 20.47 Medial to the thyrocervical trunk, identify the vertebral artery arising as the first branch of the subclavian artery.



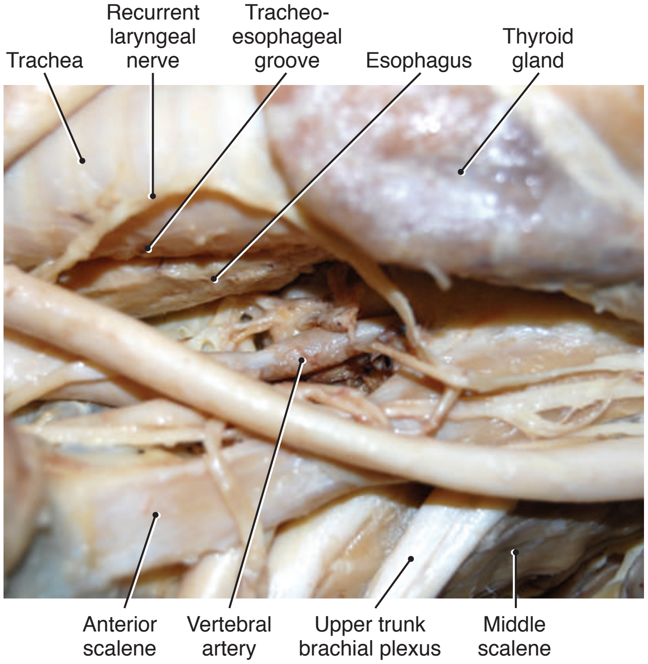
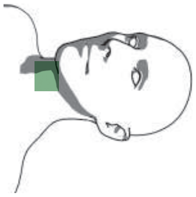

Trachea
Recurrent laryngeal nerve
Tracheo-esophageal groove
Esophagus
Thyroid gland
Anterior scalene
Vertebral artery
Upper trunk brachial plexus
Middle scalene

Fig. 20.48 Common carotid artery and thyrocervical trunk pulled laterally to identify the vertebral artery and sympathetic trunk.



- After identifying the stellate ganglion or inferior cervical ganglion, cut 2 to 3 cm of the inferior portion of the common carotid artery (Fig. 20.52). Immediately beneath this artery, identify the *thoracic duct.*

ANATOMY **NOTE**

On the left side, the thoracic duct will empty into the junction between the internal jugular and subclavian veins. On the right side, the smaller right lymphatic duct will terminate at the junction of the right internal jugular and right subclavian veins.

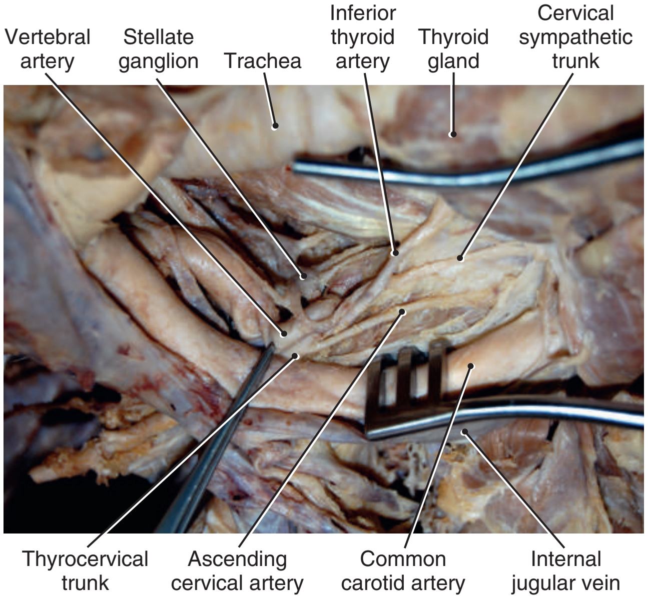
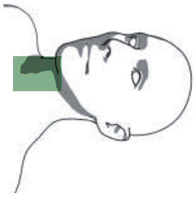

Vertebral artery
Stellate ganglion
Trachea
Inferior thyroid artery
Thyroid gland
Cervical sympathetic trunk
Thyrocervical trunk
Ascending cervical artery
Common carotid artery
Internal jugular vein

Fig. 20.49 Retractors used (as necessary) to keep common carotid artery and thyrocervical trunk reflected laterally, highlighting the sympathetic trunk with its stellate ganglion and vertebral artery.



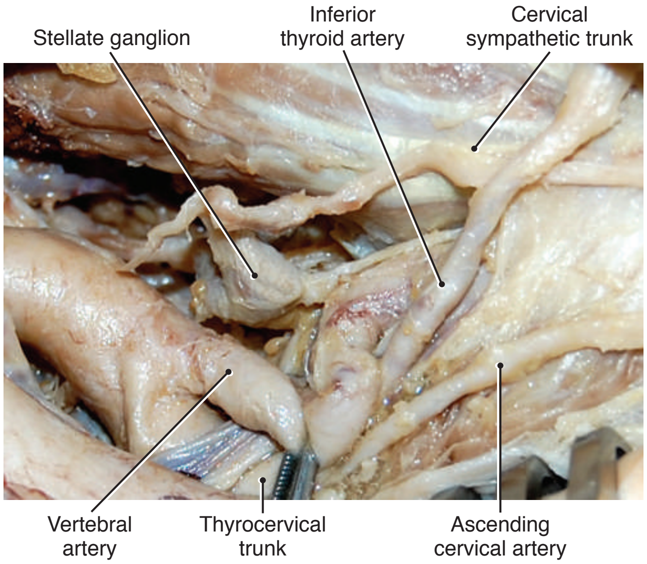
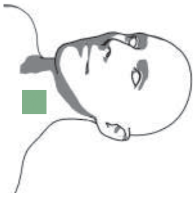

Stellate ganglion
Inferior thyroid artery
Cervical sympathetic trunk
Vertebral artery
Thyrocervical trunk
Ascending cervical artery

Fig. 20.51 Stellate ganglion, vertebral artery, and sympathetic trunk fully dissected and exposed.



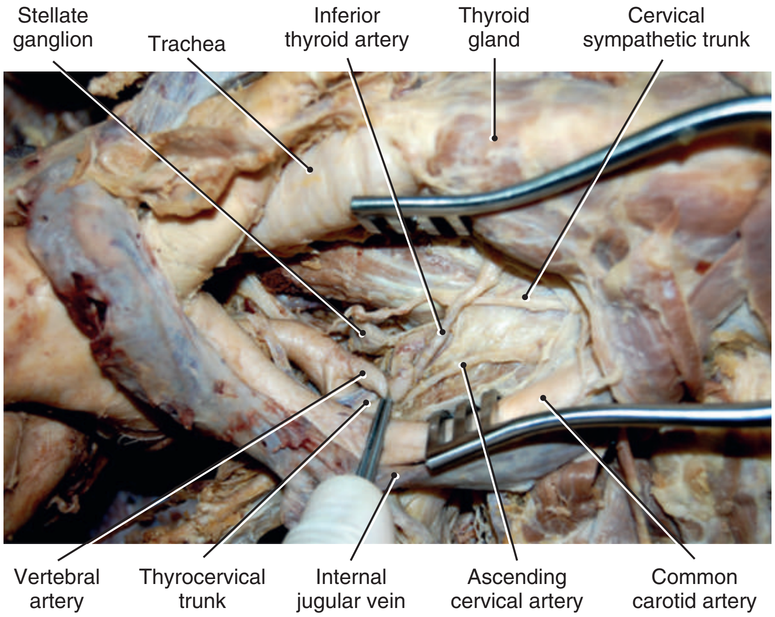
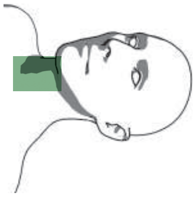

Stellate ganglion
Trachea
Inferior thyroid artery
Thyroid gland
Cervical sympathetic trunk
Vertebral artery
Thyrocervical trunk
Internal jugular vein
Ascending cervical artery
Common carotid artery

Fig. 20.50 Appreciate the stellate ganglion, vertebral artery, and sympathetic trunk fully exposed.



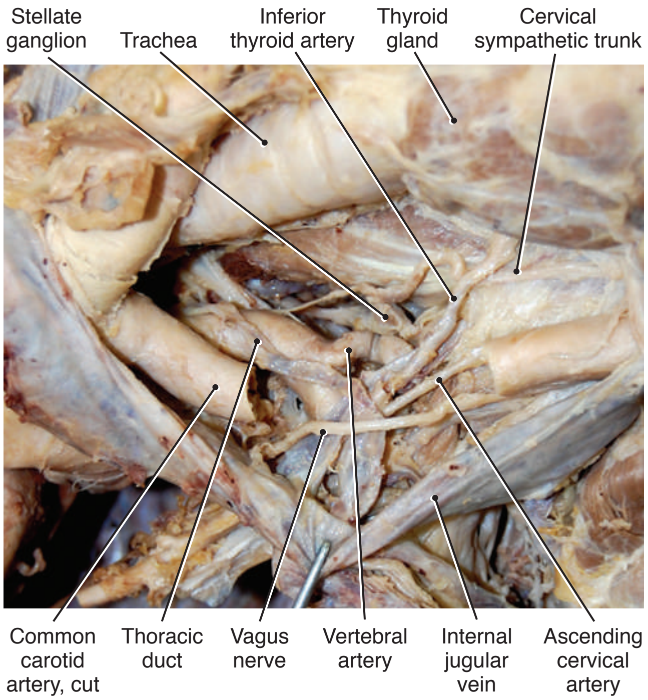
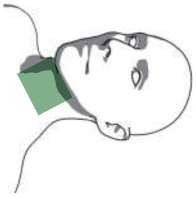

Stellate ganglion
Trachea
Inferior thyroid artery
Thyroid gland
Cervical sympathetic trunk
Common carotid artery, cut
Thoracic duct
Vagus nerve
Vertebral artery
Internal jugular vein
Ascending cervical artery

Fig. 20.52 Left common carotid artery cut, revealing the throracic duct.



DISSECTION **TIP**

The thoracic duct is located close to the stellate or inferior cervical ganglion and is often severed during this dissection.

OPTIONAL DISSECTION

ANATOMY **NOTE**

The subclavian artery gives rise to the following branches:

1. Thyrocervical trunk
2. Vertebral artery
3. Internal thoracic artery
4. Costocervical trunk

- The *costocervical trunk* is located on the deep surface of the subclavian artery posterior to the anterior scalene muscle. It usually gives off the highest intercostal artery, which supplies the uppermost intercostal spaces.
- Cut the anterior scalene muscle midway from its attachment to the first rib (Fig. 20.53).
- Look at the posterior surface of subclavian artery, and trace the costocervical trunk (Fig. 20.54).

DISSECTION **TIP**

This dissection can also take place from the internal surface of the already-dissected thorax.

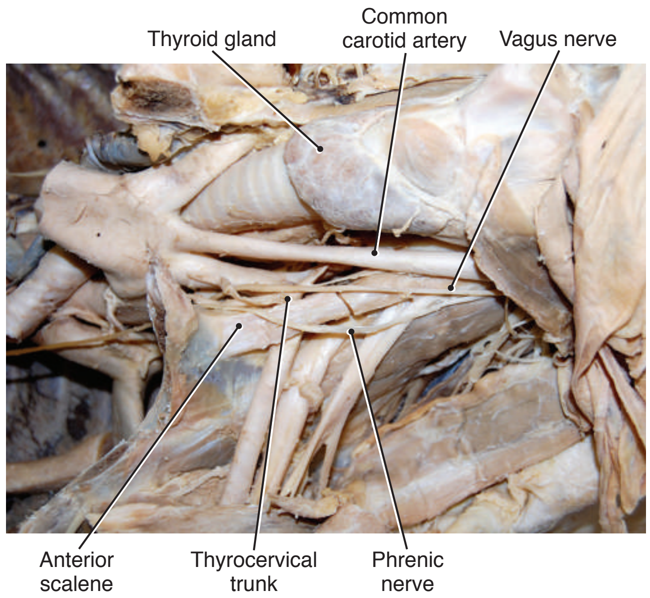
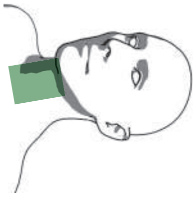

Thyroid gland
Common carotid artery
Vagus nerve
Anterior scalene
Thyrocervical trunk
Phrenic nerve

Fig. 20.53 Anterior scalene muscle cut midway from its attachment onto first rib.



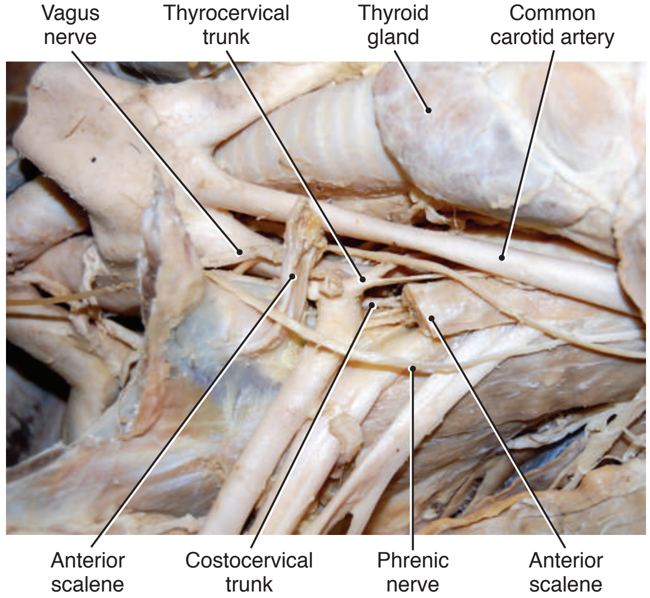
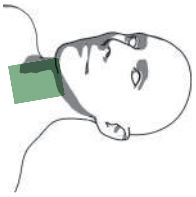

Vagus nerve
Thyrocervical trunk
Thyroid gland
Common carotid artery
Anterior scalene
Costocervical trunk
Phrenic nerve
Anterior scalene

Fig. 20.54 Anterior scalene muscle and posterior surface of subclavian artery lifted, revealing origin of costocervical trunk.



ANATOMY **NOTE**

The other branch of the costocervical trunk is the deep cervical artery, which ascends in the neck posterior to the transverse processes of the cervical vertebrae.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

Cervical Plexus

- ☐ Great auricular
- ☐ Transverse cervical
- ☐ Supraclavicular nerves
- ☐ Lesser occipital
- ☐ C1 fibers to thyrohyoid muscle
- ☐ Ansa cervicalis (C1-C3)
  - ☐ Superior root (C1)
  - ☐ Inferior root (C2 and C3)
- ☐ Phrenic (C3-C5)

Cranial Nerves (CN)

- ☐ Accessory (CN XI)
- ☐ Hypoglossal nerve (CN XII)
- ☐ Vagus nerve (CN X)
- ☐ Nerve to mylohyoid/anterior digastric muscle (CN V; from inferior alveolar nerve)
- ☐ Cervical branch from facial (CN VII)

Autonomic Nerves

- ☐ Vagus
- ☐ Superior laryngeal
  - ☐ External laryngeal
  - ☐ Internal laryngeal
  - ☐ Recurrent laryngeal
  - ☐ Inferior laryngeal
- ☐ Cervical sympathetic trunk

Ganglia

- ☐ Superior cervical
- ☐ Middle cervical
- ☐ Stellate

ARTERIES

- ☐ Common carotid
  - ☐ Internal carotid
  - ☐ External carotid
- ☐ Superior thyroid
  - ☐ Superior laryngeal
- ☐ Lingual
- ☐ Facial
- ☐ Occipital
- ☐ Ascending pharyngeal
- ☐ Subclavian
- ☐ Vertebral
- ☐ Thyrocervical trunk
  - ☐ Inferior thyroid
  - ☐ Transverse scapular
  - ☐ Suprascapular
- ☐ Dorsal scapular

VEINS

- ☐ External jugular
- ☐ Anterior jugular
- ☐ Internal jugular
  - ☐ Superior thyroid
  - ☐ Middle thyroid
- ☐ Subclavian
- ☐ Inferior thyroid veins

MUSCLES

- ☐ Platysma
- ☐ Sternocleidomastoid
  - ☐ Sternal head
  - ☐ Clavicular head
- ☐ Sternohyoid
- ☐ Omohyoid
- ☐ Sternothyroid
- ☐ Thyrohyoid
- ☐ Anterior belly of digastric
- ☐ Mylohyoid
- ☐ Posterior belly of digastric
- ☐ Stylohyoid
- ☐ Splenius capitis
- ☐ Levator scapulae
- ☐ Posterior scalene
- ☐ Middle scalene
- ☐ Anterior scalene
- ☐ Trapezius

FASCIA

- ☐ Superficial fascia
- ☐ Tela subcutanea
- ☐ Deep fascia
  - ☐ Investing layer
  - ☐ Pretracheal layer
  - ☐ Prevertebral layer

BONES

- ☐ Mandible
- ☐ Hyoid
- ☐ Manubrium
- ☐ Clavicle
- ☐ Cervical vertebrae (C1-C7)
  - ☐ Atlas (C1)
  - ☐ Axis (C2)
- ☐ Occipital
- ☐ Temporal
  - ☐ Mastoid process
  - ☐ Styloid process

CONNECTIVE TISSUE

- ☐ Thyroid cartilage
- ☐ Cricoid cartilage
- ☐ Cricothyroid ligament
- ☐ Stylohyoid ligament
- ☐ Stylomandibular ligament
- ☐ Thyrohyoid membrane

GLANDS

- ☐ Submandibular gland
- ☐ Thyroid gland
  - ☐ Right lobe
  - ☐ Left lobe
  - ☐ Pyramidal lobe
- ☐ Parathyroid glands

ATLAS REFERENCES

Netter: 42, 53–54, 83–85
McMinn: 38–41
Gray's Atlas: 503–506

BEFORE YOU BEGIN

Review the superficial anatomy of the face:

- Glabella
- Root of nose, dorsum of nose
- Tip of nose
- Ala
- Columella nasi
- Philtrum
- Mental protuberance
- Modiolus
- Vermillion border

Palpate the following facial landmarks on the cadaver:

- Jugular notch
- Mental protuberance
- Nasion
- Glabella
- Vertex
- External occipital protuberance (inion)
- Mastoid process
- Ramus, angle, and body of mandible
- Zygomatic arch
- Infraorbital margin
- Supraorbital margin
- Superciliary arch

SKIN AND SUPERFICIAL FASCIA

○ **With a marker, outline the dissection for the cadaver as follows (Fig. 21.1):**

1. Make a line from the mental protuberance to the vertex. The line should encircle the lips, nostrils, and eyelids.
2. Make a second line from the mental protuberance to the lobule of the ear.
3. Make a third line from the vertex to the upper part of the helix of the ear.

○ **Identify the six major surface regions (temporal, frontal, zygomatic, maxillary, mandibular, mental).**

○ **Based on the lines drawn, make an incision between the angle of the mandible and the mental protuberance (Fig. 21.2).**

○ **Carefully reflect the flaps of skin (from medial to lateral) created by the incisions (Figs. 21.3 and 21.4).**

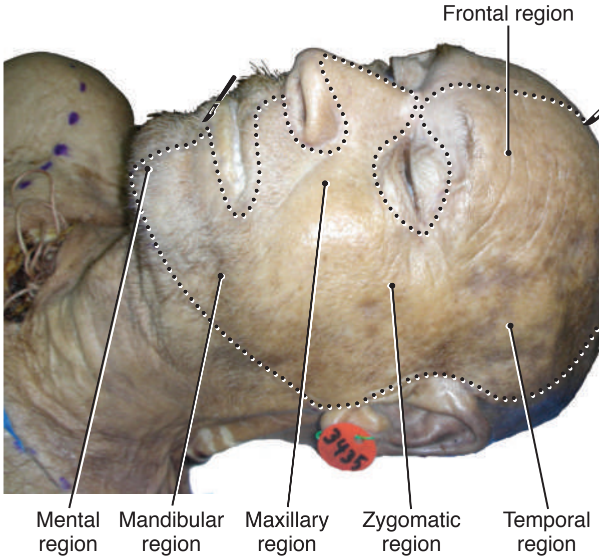

Frontal region
Mental region
Mandibular region
Maxillary region
Zygomatic region
Temporal region

Fig. 21.1 Anterolateral facial view with stippled lines for incisions, showing the six major surface regions.

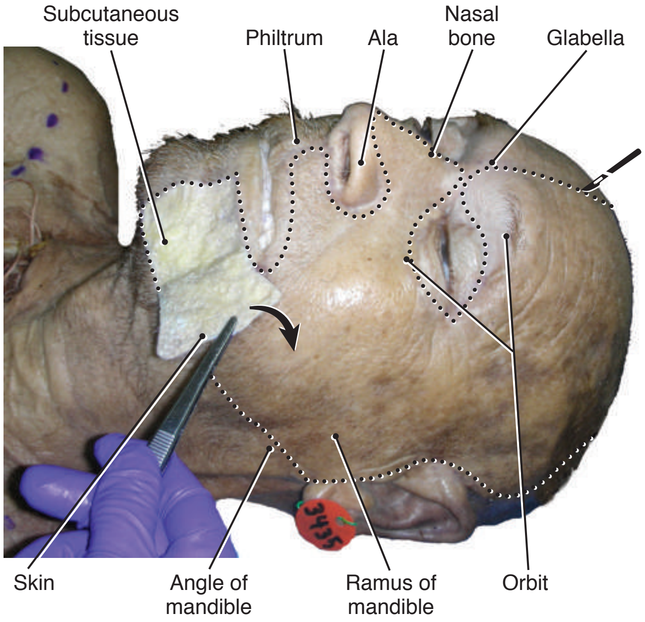

Subcutaneous tissue
Philtrum
Ala
Nasal bone
Glabella
Skin
Angle of mandible
Ramus of mandible
Orbit

Fig. 21.2 Anterolateral facial view with skin reflected from the mental region and facial landmarks.

ANATOMY **NOTE**

Beneath the skin, notice the surface of the face covered almost entirely by fat. This fibrofatty tissue is also known as the **superficial musculoaponeurotic space** or system (SMAS) (Fig. 21.5).

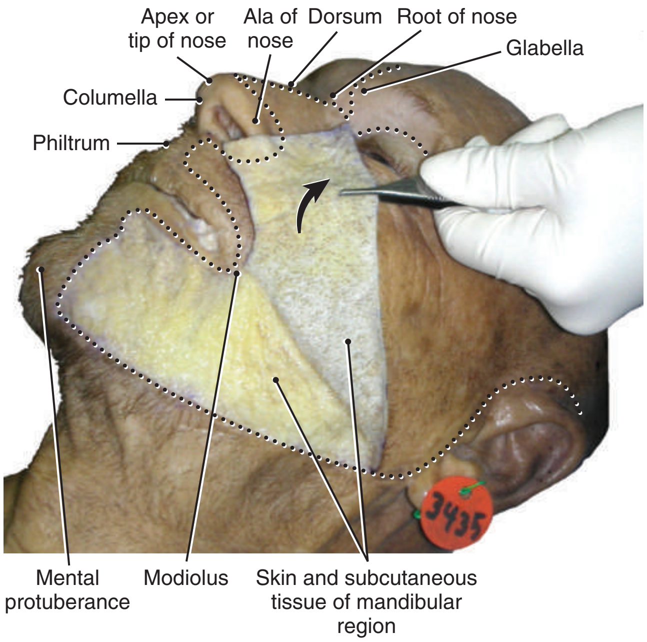

Apex or tip of nose
Ala of nose
Dorsum
Root of nose
Glabella
Columella
Philtrum
Mental protuberance
Modiolus
Skin and subcutaneous tissue of mandibular region

Fig. 21.3 Anterolateral facial view with skin reflected from the mandibular region.

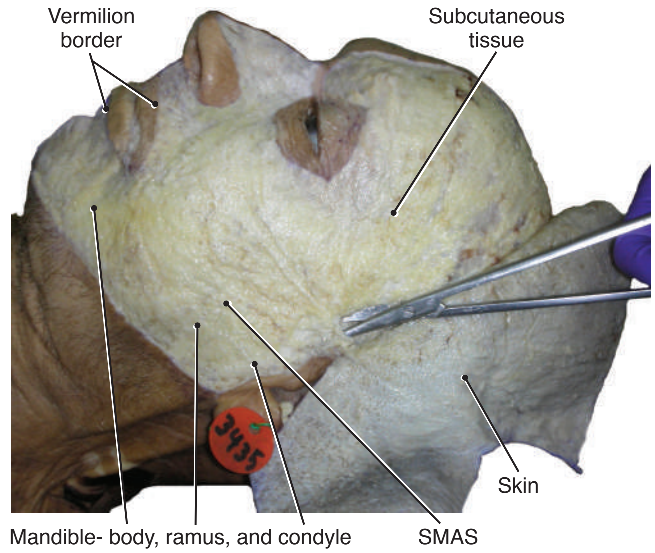

Vermilion border
Subcutaneous tissue
Skin
Mandible- body, ramus, and condyle
SMAS

Fig. 21.5 Lateral facial view with skin reflected from mandibular, maxillary, zygomatic, frontal, and temporal regions.

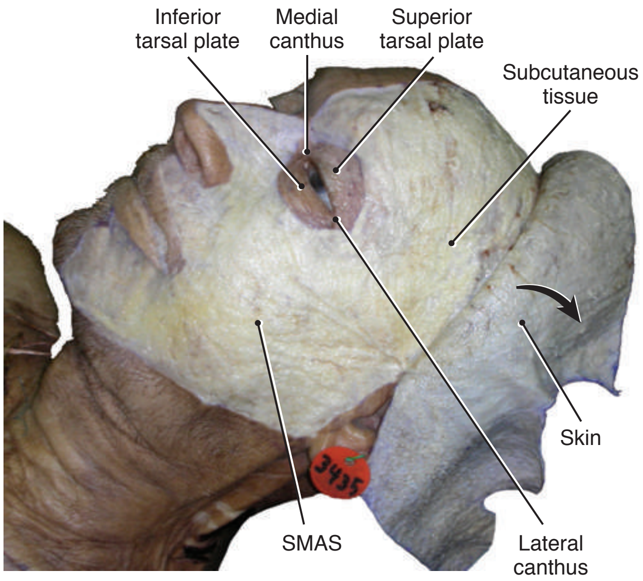

Inferior tarsal plate
Medial canthus
Superior tarsal plate
Subcutaneous tissue
Skin
SMAS
Lateral canthus

Fig. 21.4 Lateral facial view with skin reflected from mandibular, maxillary, zygomatic, frontal, and temporal regions.

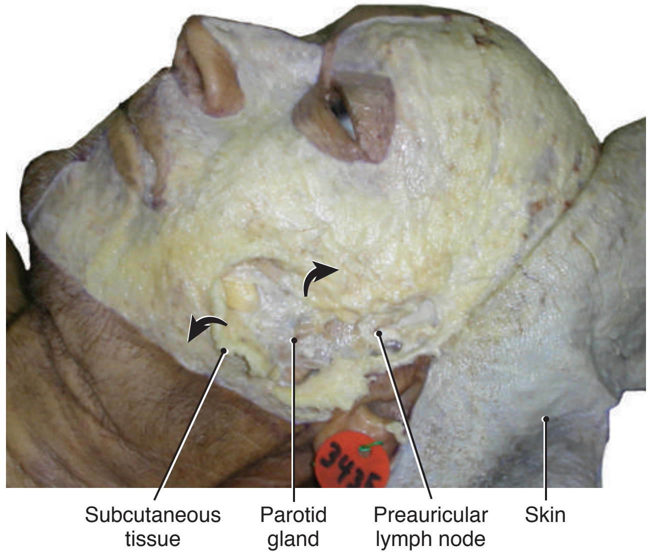

Subcutaneous tissue
Parotid gland
Preauricular lymph node
Skin

Fig. 21.6 Lateral facial view with skin reflected and SMAS removed from the mandibular region.

DISSECTION **TIP**

The muscles of facial expression vary in thickness. Pay special attention when removing the skin and SMAS to avoid cutting any muscles, because many attach directly into the skin.

PAROTID GLAND

- Situated in front of the ear (auricle), the parotid gland is covered with variable amounts of fat. Using the separating technique with your scissors, reflect as much fat as possible.
- Identify the substance of the parotid gland, which typically extends into the space between the zygomatic arch and the angle of the mandible (Fig. 21.6).

ANATOMY **NOTE**

The parotid gland is covered by a dense fibrous capsule, which sends septae into the gland, dividing it into lobules.

- Begin to reflect the SMAS medially over the mandibular region to reveal the parotid gland (see Fig. 21.5).
- Continue to remove the SMAS from the mandibular region (Fig. 21.7).

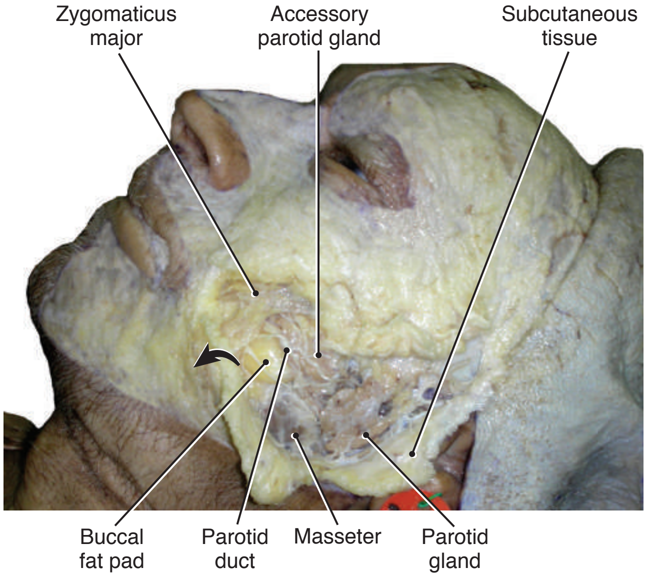

Zygomaticus major
Accessory parotid gland
Subcutaneous tissue
Buccal fat pad
Parotid duct
Masseter
Parotid gland

Fig. 21.7 Lateral facial view with skin reflected and SMAS removed from the mandibular region.

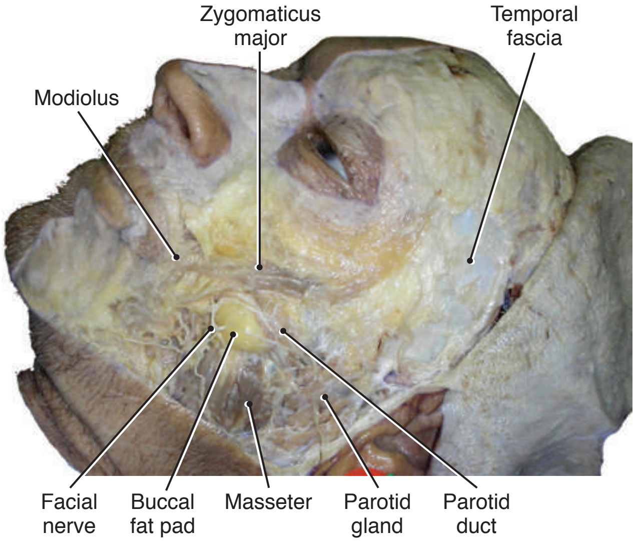

Zygomaticus major
Temporal fascia
Modiolus
Facial nerve
Buccal fat pad
Masseter
Parotid gland
Parotid duct

Fig. 21.8 Lateral facial view with skin reflected and SMAS removed from mandibular, maxillary, and temporal regions.

- Identify the **parotid duct**, usually found emerging from the anterior edge of the parotid gland, about 1 inch (2.5 cm) inferior to the zygomatic arch (Figs. 21.7 and 21.8).

ANATOMY **NOTE**

From this point, the parotid duct passes horizontally across the masseter muscle, then turns around the anterior edge of the masseter and pierces the buccinator muscle (Fig. 21.9).

- Remove the SMAS from the maxillary and temporal regions (see Fig. 21.8).

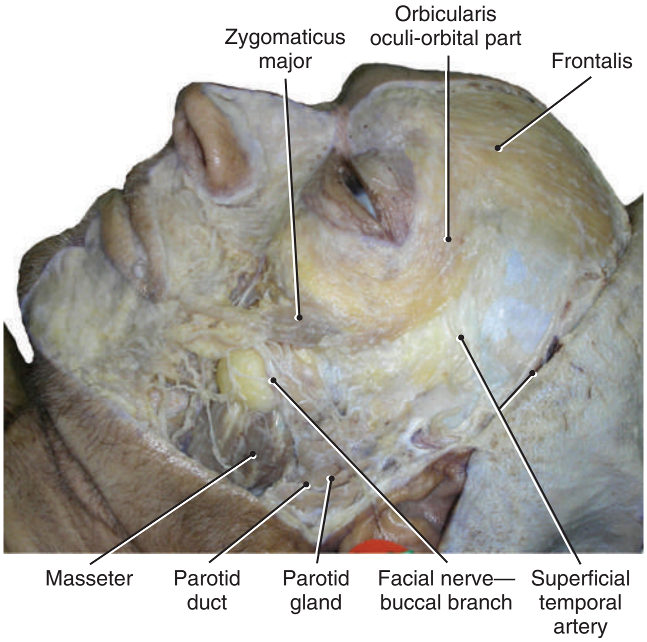

Zygomaticus major
Orbicularis oculi-orbital part
Frontalis
Masseter
Parotid duct
Parotid gland
Facial nerve—buccal branch
Superficial temporal artery

Fig. 21.9 Lateral facial view with skin reflected and subcutaneous tissue removed from the mandibular, maxillary, and orbital regions.

- Note the following structures: zygomaticus major muscle, masseter muscle, and temporal fascia (see Figs. 21.7 and 21.8).
- Identify the buccal fat pad.

ANATOMY **NOTE**

The buccal fat pad is an encapsulated mass of adipose tissue, which lies between the masseter and buccinator muscles.

DISSECTION **TIP**

An accessory parotid gland can often be identified along the parotid duct in its course across the masseter muscle (see Figs. 21.7 and 21.8).

MIMETIC MUSCLES

- Clean the mimetic muscles, taking care to preserve the branches of the facial nerve, which innervate them.
- Remove the SMAS from the orbital region and identify the frontalis and orbicularis oculi muscles (see Fig. 21.9 and Plate 21.1).
- Identify the parts of the orbicularis oculi muscles:
  - Orbital
  - Palpebral
  - Lacrimal
- Identify the superficial temporal artery just superior to the zygomatic arch in front of the external acoustic meatus (see Fig. 21.9).

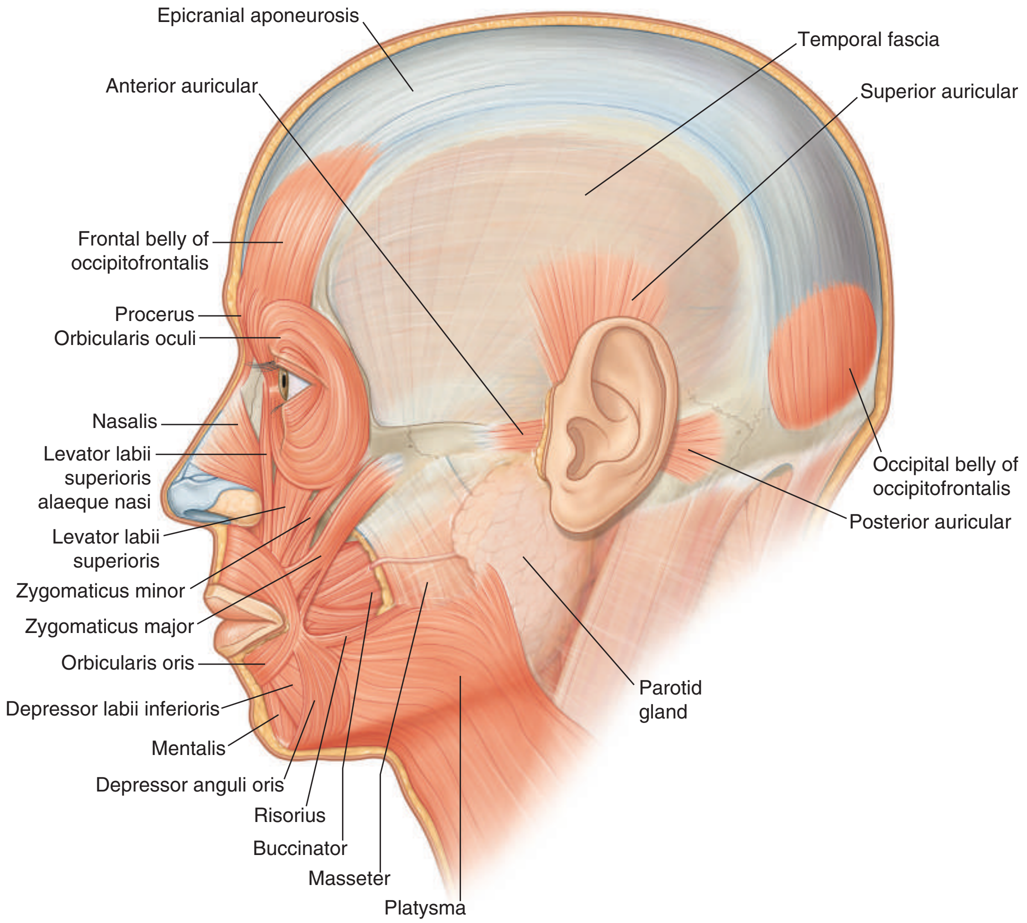

Epicranial aponeurosis
Temporal fascia
Anterior auricular
Superior auricular
Frontal belly of occipitofrontalis
Procerus
Orbicularis oculi
Nasalis
Levator labii superioris alaeque nasi
Levator labii superioris
Zygomaticus minor
Zygomaticus major
Orbicularis oris
Depressor labii inferioris
Mentalis
Depressor anguli oris
Risorius
Buccinator
Masseter
Platysma
Occipital belly of occipitofrontalis
Posterior auricular
Parotid gland

Plate 21.1 Lateral view of the muscles of facial expression.

ANATOMY **NOTE**

The auriculotemporal nerve can be found just posterior to this artery.

DISSECTION **TIP**

The transverse facial artery runs superior to the parotid duct, but because of its small size, identifying this artery is often difficult.

○ **Identify several of the mimetic muscles (Fig. 21.10):**

○ **The muscle surrounding the lips is the *orbicularis oris*.**

DISSECTION **TIP**

Often you will need to remove additional skin from the margins of the lips to expose the orbicularis oris fully. Fibers from several other facial muscles merge with the orbicularis oris, including the buccinator and the elevators and depressors of the angles of the mouth.

○ **Identify the zygomaticus major muscles.**

○ **Identify the zygomaticus minor muscles.**

○ **Identify the depressor anguli oris muscles.**

○ **Identify the depressor labii inferioris muscles.**

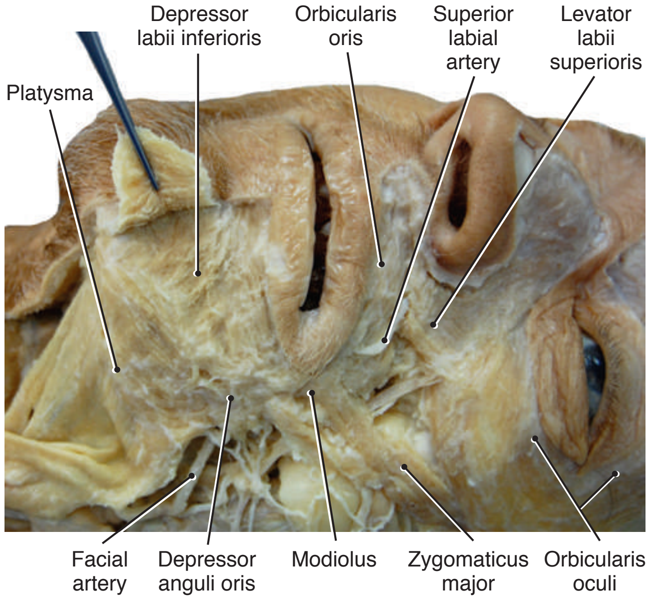

Depressor labii inferioris
Orbicularis oris
Superior labial artery
Levator labii superioris
Platysma
Facial artery
Depressor anguli oris
Modiolus
Zygomaticus major
Orbicularis oculi

Fig. 21.10 Anterior view of mandible and neck with skin removed, revealing muscles.

- Identify the levator labii superioris alaeque nasi muscles.
- Identify the buccinator muscle.
- The platysma muscle has been identified in the dissection of the neck (see Chapter 20).

DISSECTION **TIP**

Some platysma fibers pass up over the lower border of the mandible and mingle with the depressor muscles of the lips and with the risorius muscle more laterally.

FACIAL NERVE

- Identify the *buccal branch* of the facial nerve, which usually runs alongside the parotid duct (Fig. 21.11).

DISSECTION **TIP**

Tracing the branches of the facial nerve can be challenging. In some specimens, some of the parotid lymph nodes may be encountered as the gland is dissected.

- After you have exposed the buccal branch of the facial nerve, carefully trace it into the substance of the parotid gland until you find its junction(s) with other branches.
- Dissect out the other branches of the facial nerve to their target muscles (Fig. 21.12). Landmarks for other branches of the facial nerve follow:
  - *Temporal* branch: Dissect near the posterior part of the zygomatic arch.
  - *Zygomatic* branch: Dissect around the zygomaticus major muscle at the base of the zygomatic bone.
  - *Buccal* branch: Runs parallel to the parotid duct and crosses the masseter muscle.
  - *Marginal mandibular* branch: Dissect at the posteroinferior margin of the mandible.
  - *Cervical* branch: Dissect deep to the platysma muscle, approximately one fingerbreadth posterior to the angle of the mandible.

ANATOMY **NOTE**

The facial nerve typically bifurcates into temporofacial and cervicofacial divisions (see Fig. 21.12).

- Identify the terminal branches of the facial nerve:
  - Temporal
  - Zygomatic
  - Buccal
  - Marginal mandibular
  - Cervical

ANATOMY **NOTE**

The terminal branches of the facial nerve often connect to one another or with infraorbital branches of the trigeminal nerve.

DISSECTION **TIP**

Several branches of the facial nerve are not identified with the cadaver in the supine position, including the posterior auricular nerve, which innervates musculature of the external ear and the occipitalis muscle, and the digastric branch, which supplies the posterior belly of the digastric muscle and the stylohyoid muscle.

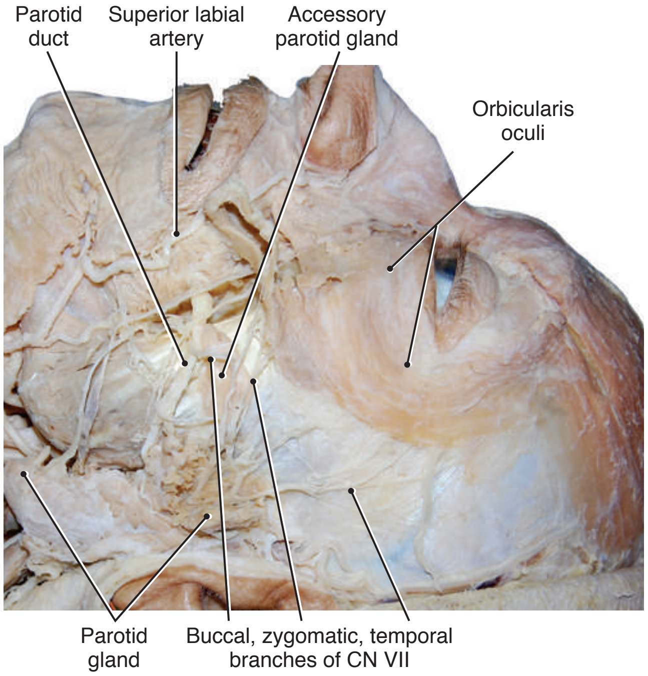

Parotid duct
Superior labial artery
Accessory parotid gland
Orbicularis oculi
Parotid gland
Buccal, zygomatic, temporal branches of CN VII

Fig. 21.11 Anterolateral view of face with skin and subcutaneous tissue removed.

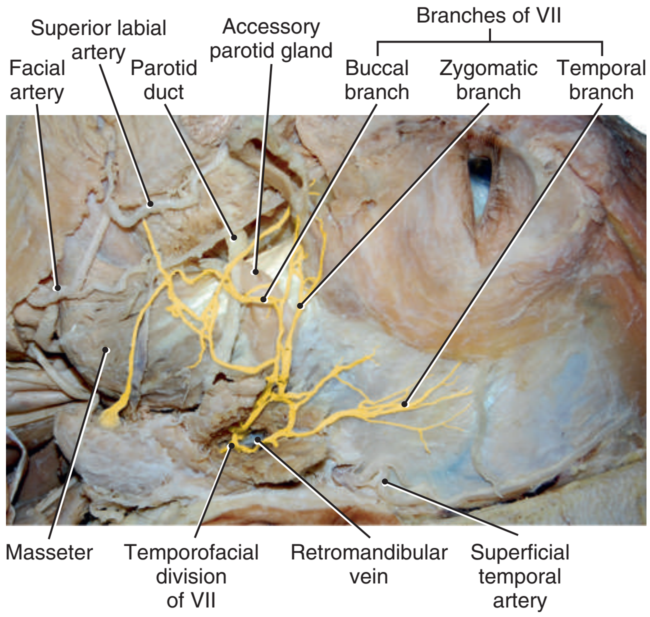

Superior labial artery
Accessory parotid gland
Branches of VII
Facial artery
Parotid duct
Buccal branch
Zygomatic branch
Temporal branch
Masseter
Temporofacial division of VII
Retromandibular vein
Superficial temporal artery

Fig. 21.12 Anterolateral view of face with skin and subcutaneous tissue removed.

BUCCAL FAT PAD

- After you expose all terminal branches of the facial nerve, identify and remove the *buccal fat pad*, an encapsulated mass of adipose tissue, which lies between the masseter and buccinator muscles (Figs. 21.13 and 21.14).
- Trace the parotid duct to its point of penetration into the buccinator muscle.
- Lift the buccal fat bad with forceps, and use scissors to cut its attachments to nearby structures (Figs. 21.14 and 21.15).
- Pay special attention to preserve the neurovascular structures in the area as you remove the fat pad.

DISSECTION **TIP**

As you remove the buccal fat pad, you will probably notice branches of the buccal artery and nerve. The buccal nerve usually is located between the masseter and buccinator muscles and follows the anterior border of the temporalis muscle to its insertion onto the coronoid process of the mandible. Do not spend time completely exposing the temporalis now; this occurs during the infratemporal area dissection (Chapter 22).

ARTERIES OF THE FACE

- Identify the superior labial artery within the substance of the orbicularis oris muscle.
- Expose the *superior labial artery*, and trace it backward toward the angle of the mandible (see Fig. 21.11).
- The *facial artery* is hidden along part of its course by the submandibular gland and by several mimetic muscles. Identify the facial artery as it becomes superficial at the inferior border of the mandible near its angle. It then crosses the cheek, passes near the

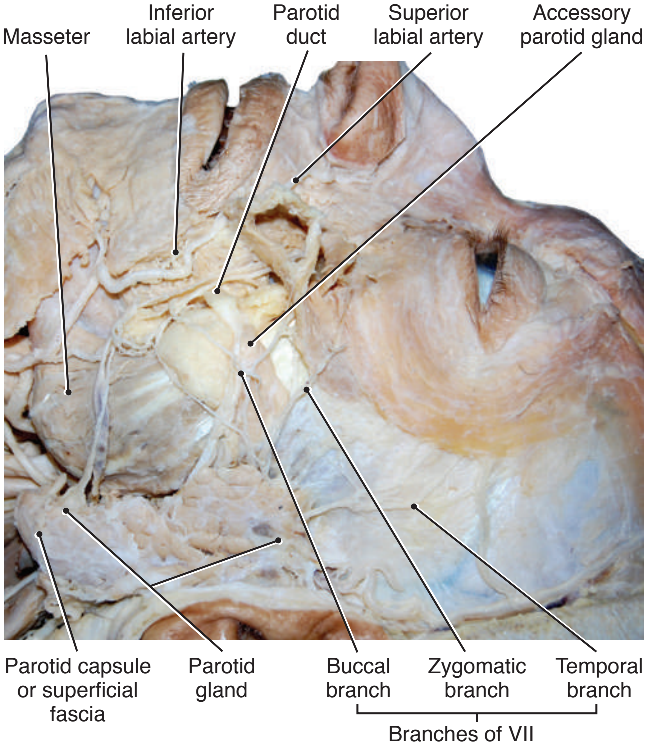

Masseter
Inferior labial artery
Parotid duct
Superior labial artery
Accessory parotid gland
Parotid capsule or superficial fascia
Parotid gland
Buccal branch
Zygomatic branch
Temporal branch
Branches of VII

Fig. 21.13 Anterolateral view of face with skin and subcutaneous tissue removed, revealing temporofacial division of the facial nerve and its branches.

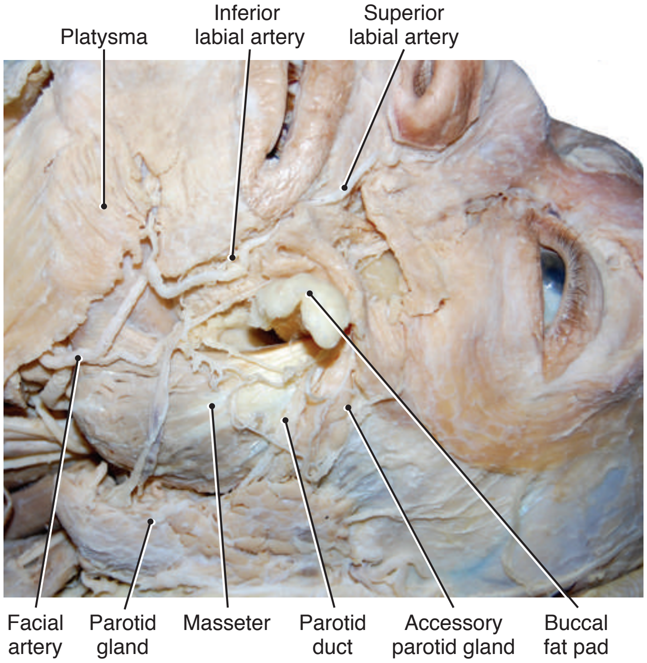

Platysma
Inferior labial artery
Superior labial artery
Facial artery
Parotid gland
Masseter
Parotid duct
Accessory parotid gland
Buccal fat pad

Fig. 21.14 Anterolateral view of face with skin and subcutaneous tissue removed.

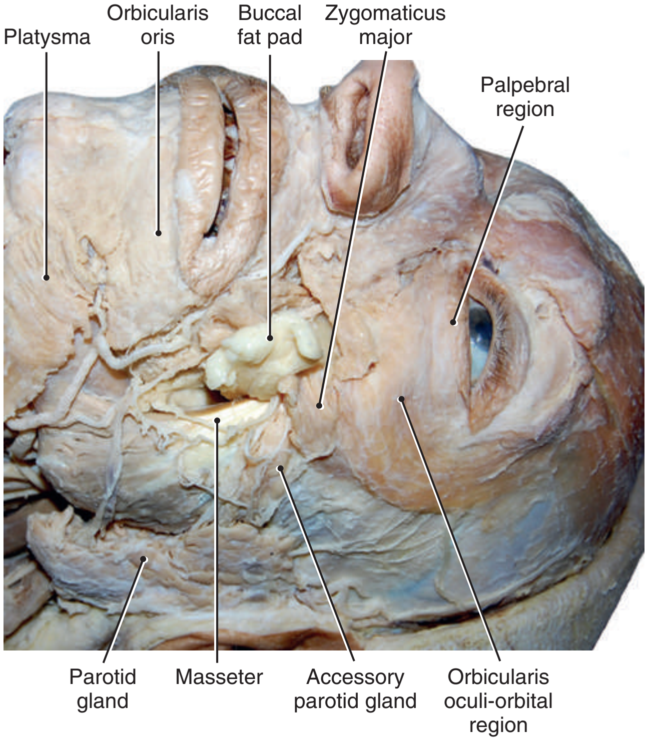

Platysma
Orbicularis oris
Buccal fat pad
Zygomaticus major
Palpebral region
Parotid gland
Masseter
Accessory parotid gland
Orbicularis oculi-orbital region

Fig. 21.15 Anterolateral view of face with skin and subcutaneous tissue removed.

angle of the mouth, and ends near the medial angle of the eye as the *angular artery* (Plate 21.2).

- Medially reflect any of the mimetic muscles covering the facial artery. Once the facial artery is exposed, continue exposing the terminal part, the angular artery.

DISSECTION **TIP**

The facial artery will terminate in approximately 50% of the specimens as the angular artery. The course of the facial artery is tortuous and in contact with the facial vein, which lies just posterior to it.

- With scissors, remove the platysma, depressor labii inferioris, and depressor anguli oris muscles medially over the periosteum of the mandible (see Fig. 21.17).

TRIGEMINAL NERVE

- Expose the fibers of the platysma muscle (Fig. 21.16).
- With scissors, remove the platysma, depressor labii inferioris, and depressor anguli oris muscles medially over the periosteum of the mandible (Fig. 21.17).
- Identify the mental foramen and the mental nerve (Fig. 21.18).

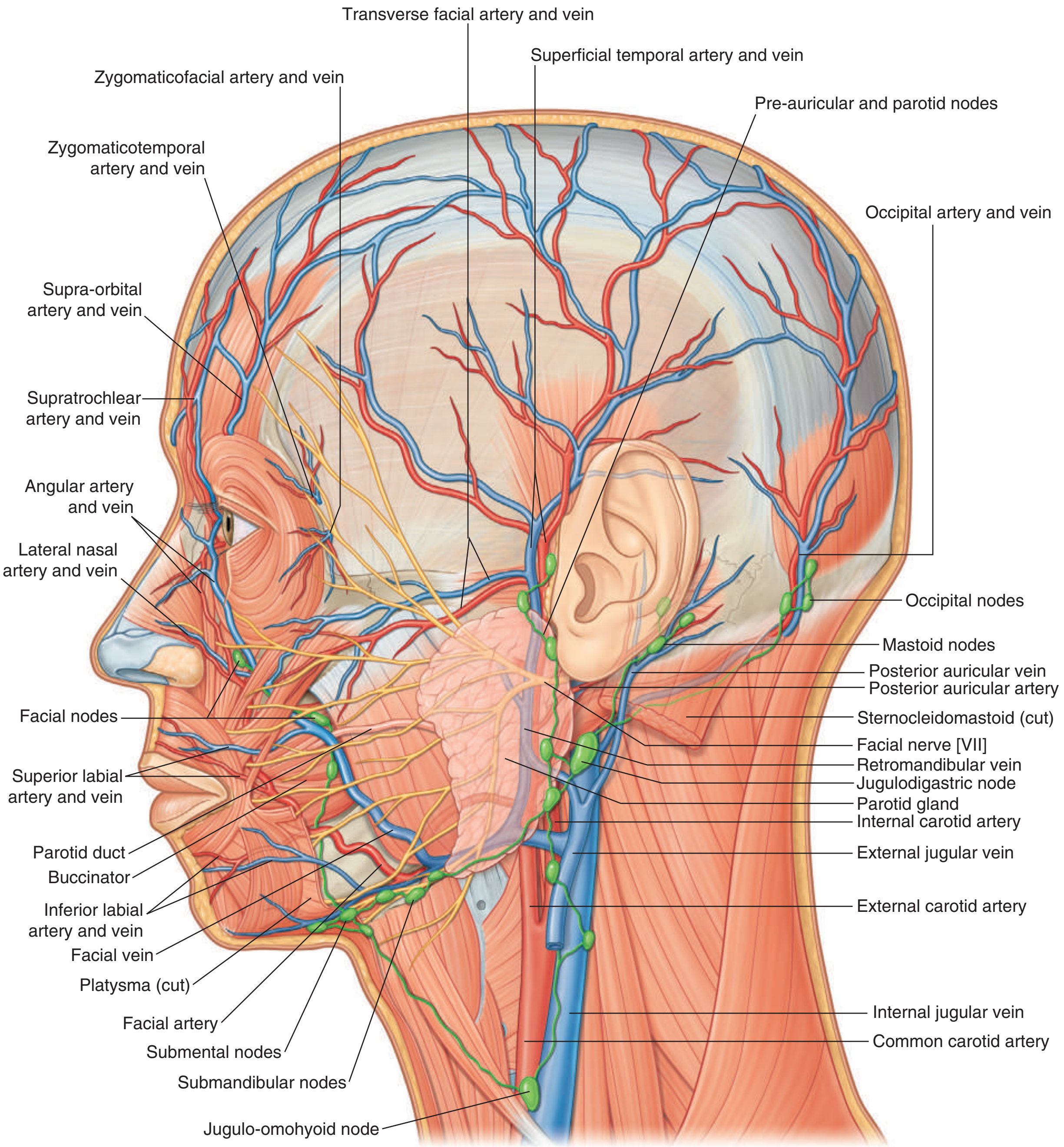

Transverse facial artery and vein
Superficial temporal artery and vein
Zygomaticofacial artery and vein
Pre-auricular and parotid nodes
Zygomaticotemporal artery and vein
Occipital artery and vein
Supra-orbital artery and vein
Supratrochlear artery and vein
Angular artery and vein
Lateral nasal artery and vein
Occipital nodes
Mastoid nodes
Posterior auricular vein
Posterior auricular artery
Facial nodes
Sternocleidomastoid (cut)
Facial nerve [VII]
Superior labial artery and vein
Retromandibular vein
Jugulodigastric node
Parotid gland
Internal carotid artery
Parotid duct
External jugular vein
Buccinator
Inferior labial artery and vein
External carotid artery
Facial vein
Platysma (cut)
Facial artery
Internal jugular vein
Common carotid artery
Submental nodes
Submandibular nodes
Jugulo-omohyoid node

Plate 21.2 Lateral view of muscles of the facial expression with accompanying nerves and arteries.

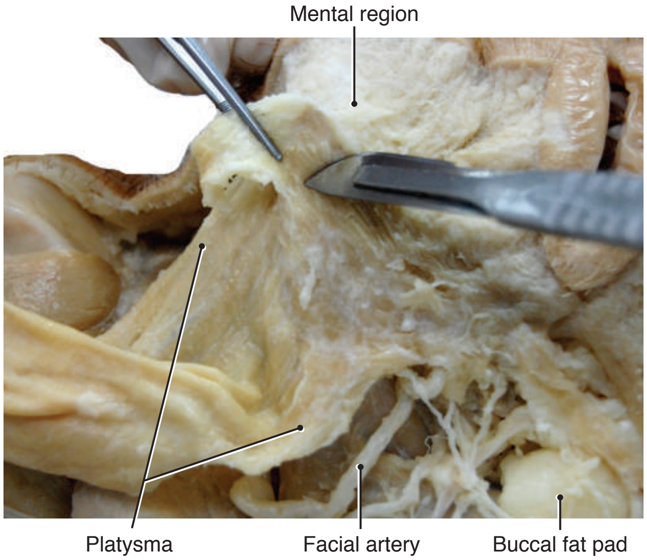
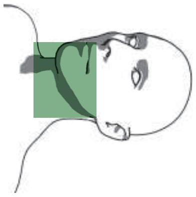

Mental region
Platysma
Facial artery
Buccal fat pad

Fig. 21.16 Anterolateral view of the face and neck with skin and subcutaneous tissue removed.



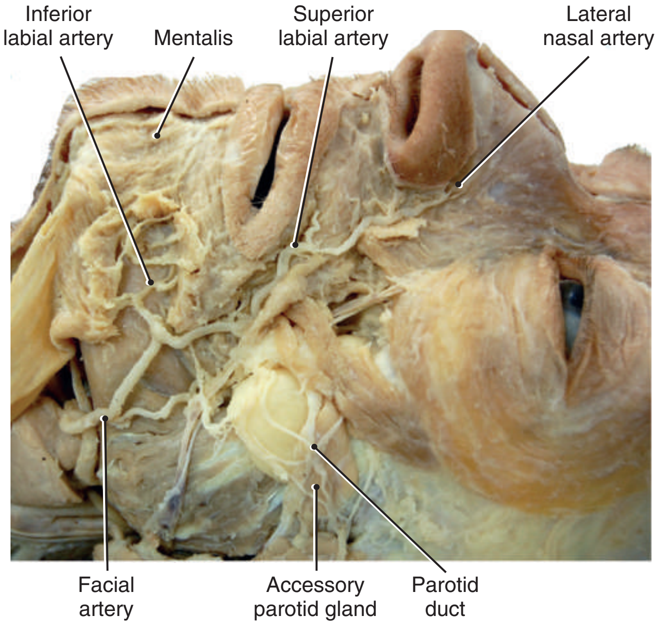

Inferior labial artery
Mentalis
Superior labial artery
Lateral nasal artery
Facial artery
Accessory parotid gland
Parotid duct

Fig. 21.18 Anterolateral view of face and neck with skin and subcutaneous tissue removed.

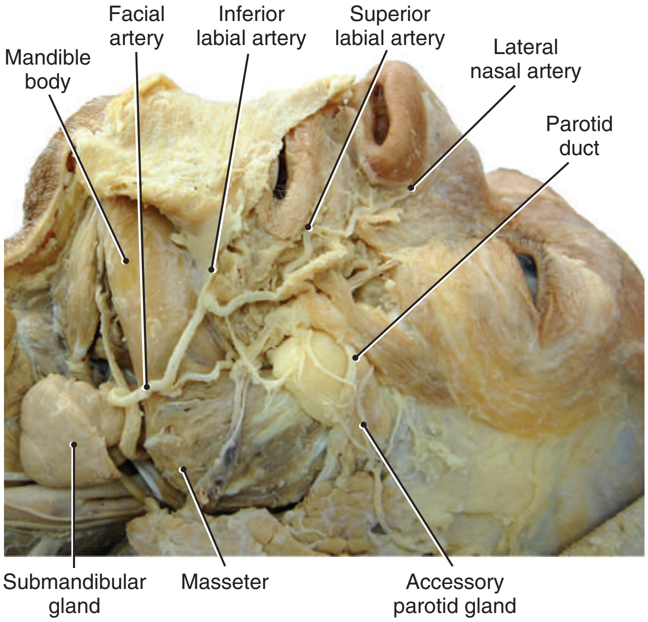

Mandible body
Facial artery
Inferior labial artery
Superior labial artery
Lateral nasal artery
Parotid duct
Submandibular gland
Masseter
Accessory parotid gland

Fig. 21.17 Anterolateral view of face and neck with skin and subcutaneous tissue removed.

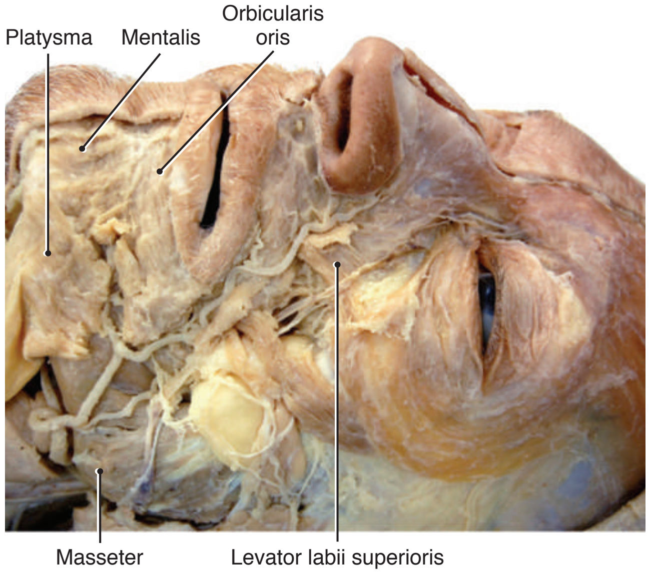

Platysma
Mentalis
Orbicularis oris
Masseter
Levator labii superioris

Fig. 21.19 Anterolateral view of face and neck with skin and subcutaneous tissue removed.

DISSECTION **TIP**

One way to identify the infraorbital and mental nerves is to draw an imaginary line from the supraorbital notch vertically to the mandible, which will pass over, or near, the infraorbital and mental foramina.

- **Detach the inferior part of the orbicularis oris superiorly from the inferior orbital rim (medial to zygomaticus major muscle) (Fig. 21.19).**
- **Detach the levator labii superioris alaeque nasi medially, and identify the infraorbital nerve (Figs. 21.20 to 21.22).**
- **Reflect the superior part of the orbicularis oculi muscle, and identify the superior tarsal plate (Figs. 21.23 and 21.24).**
- **Reflect the superior tarsal plate, and notice the fascia of the levator palpebrae superioris muscle (Fig. 21.25).**

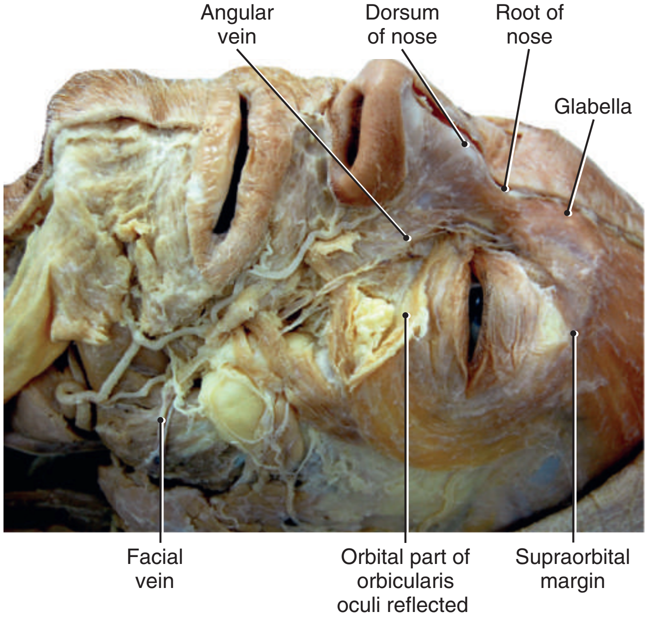

Angular vein
Dorsum of nose
Root of nose
Glabella
Facial vein
Orbital part of orbicularis oculi reflected
Supraorbital margin

Fig. 21.20 Anterolateral view of face and neck with skin and subcutaneous tissue removed and orbital part of orbicularis oculi reflected.

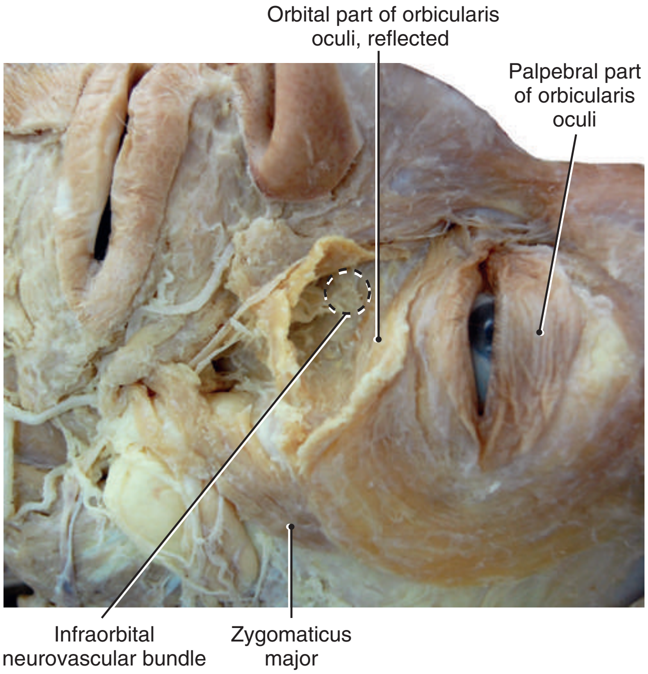
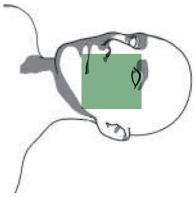

Orbital part of orbicularis oculi, reflected
Palpebral part of orbicularis oculi
Infraorbital neurovascular bundle
Zygomaticus major

Fig. 21.21 Anteromedial view of nasal, orbital, and maxillary region with skin and subcutaneous tissue removed.



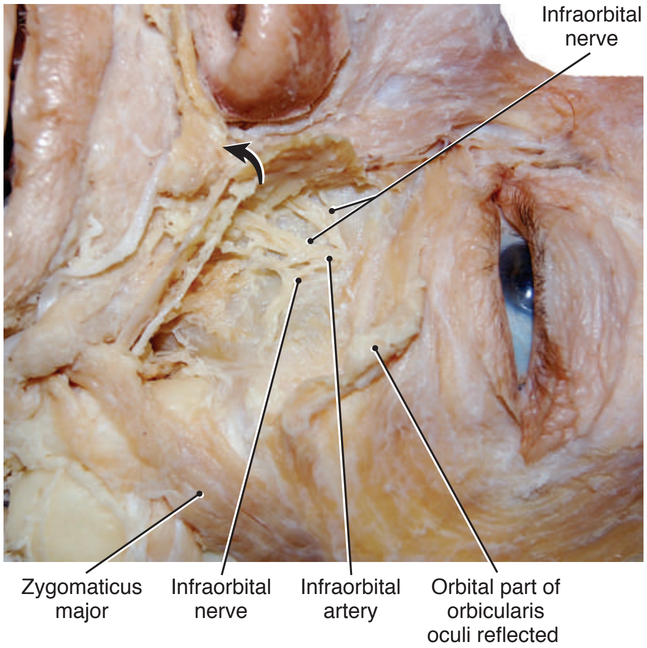
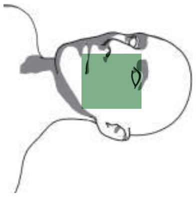

Infraorbital nerve
Zygomaticus major
Infraorbital nerve
Infraorbital artery
Orbital part of orbicularis oculi reflected

Fig. 21.22 Anteroinferior view of orbital region with skin and subcutaneous tissue removed and orbital part of orbicularis oculi reflected.



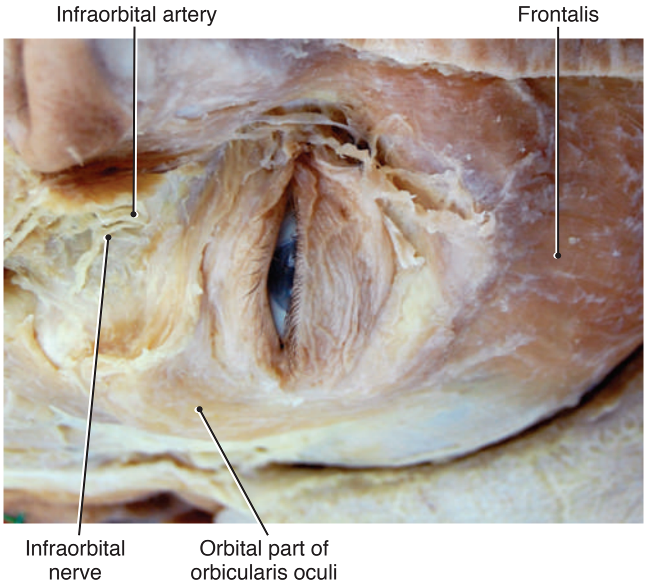
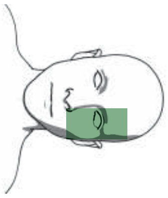

Infraorbital artery
Frontalis
Infraorbital nerve
Orbital part of orbicularis oculi

Fig. 21.23 Anteroinferior view of orbital region with skin and subcutaneous tissue removed.



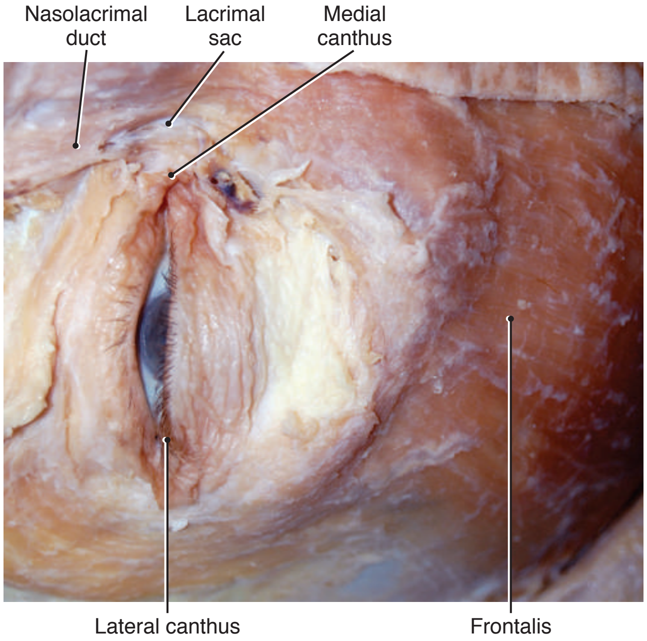
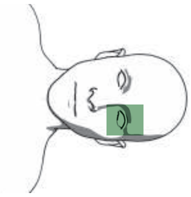

Nasolacrimal duct
Lacrimal sac
Medial canthus
Lateral canthus
Frontalis

Fig. 21.24 Anterior view of orbital region with skin and subcutaneous tissue removed.



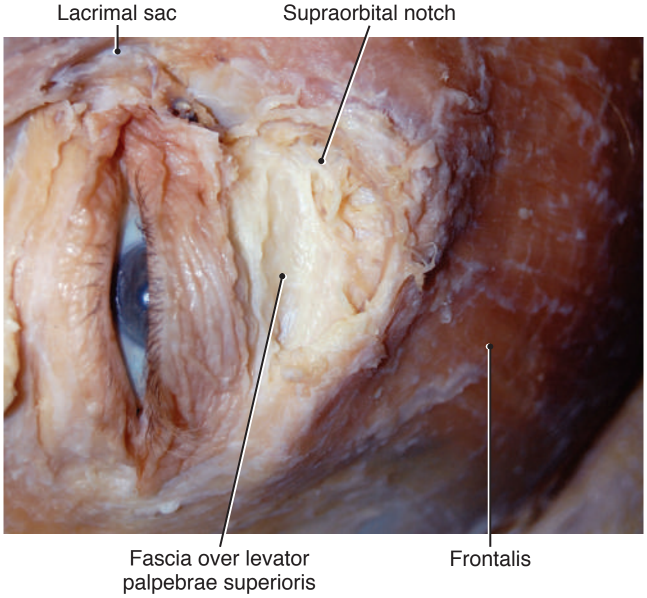
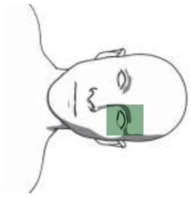

Lacrimal sac
Supraorbital notch
Fascia over levator palpebrae superioris
Frontalis

Fig. 21.25 Anterior view of orbital region with skin and subcutaneous tissue removed.



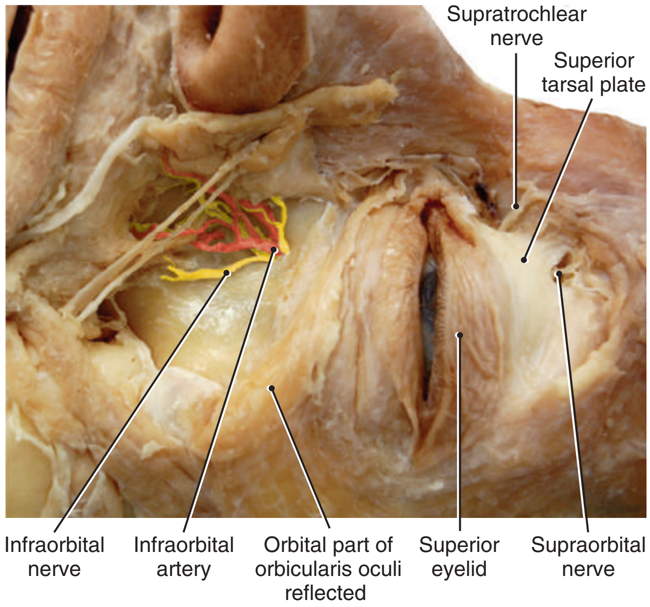
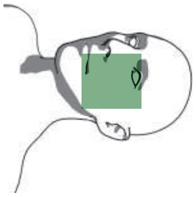

Supratrochlear nerve
Superior tarsal plate
Infraorbital nerve
Infraorbital artery
Orbital part of orbicularis oculi reflected
Superior eyelid
Supraorbital nerve

Fig. 21.26 Anterior superior view of orbital region with skin removed.



- ○ **Palpate the supraorbital notch, and with scissors, separate the muscle fibers and the connective tissue superficial (inferior and superior) to the notch to expose the *supraorbital nerve* (Fig. 21.26).**
- ○ **Identify the superficial temporal vein. This vein joins the maxillary vein to form the retromandibular vein.**

DISSECTION **TIP**

In most specimens the supraorbital nerve, artery, and vein emerge through the orbital septum and superior tarsal plate (see Fig. 21.26), whereas the supratrochlear nerve emerges medially (Fig. 21.27).

- ○ **You may remove the parotid gland now (Fig. 21.28), or during the dissection of the infratemporal fossa (Chapter 22).**

VEINS OF THE FACE

- ○ **Identify the *retromandibular vein* deep to the facial nerve.**

ANATOMY **NOTE**

The retromandibular vein splits into anterior and posterior divisions; the posterior division joins the posterior auricular vein to form the external jugular vein, and the anterior division joins the facial vein to form the common facial vein.

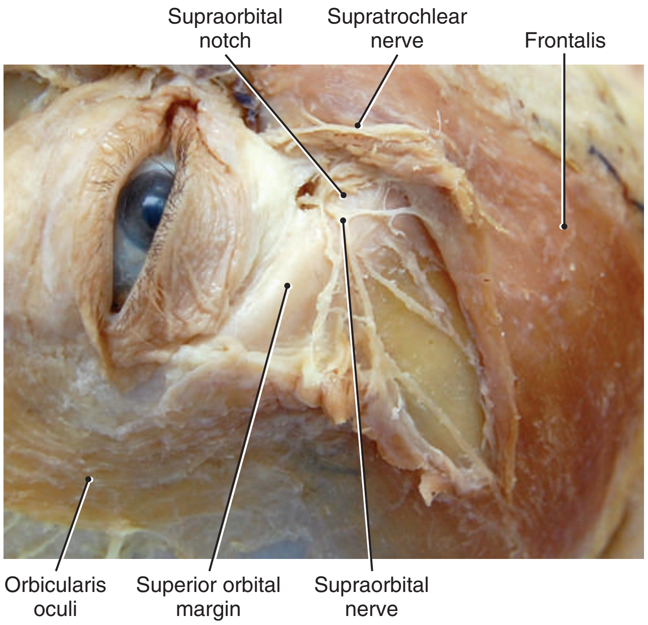
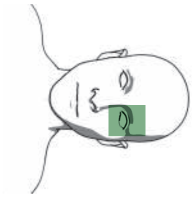

Supraorbital notch
Supratrochlear nerve
Frontalis
Orbicularis oculi
Superior orbital margin
Supraorbital nerve

Fig. 21.27 Anterosuperior view of orbital region with skin and subcutaneous tissue removed.



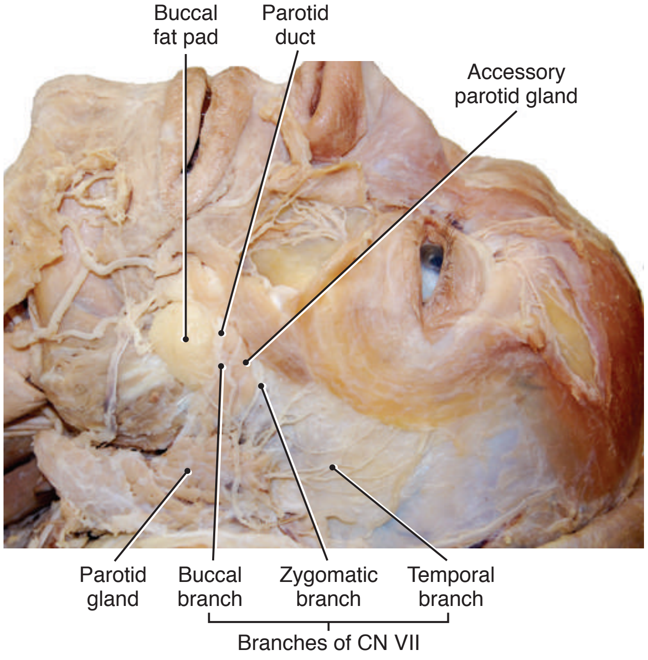

Buccal fat pad
Parotid duct
Accessory parotid gland
Parotid gland
Buccal branch
Zygomatic branch
Temporal branch
Branches of CN VII

Fig. 21.28 Anterolateral view of face with skin and subcutaneous tissue removed.

- Identify and trace the *facial vein,* and look for its drainage into the common facial vein (Fig. 21.29).
- The facial vein begins at the medial orbit as the angular vein, then courses with the facial artery toward the angle of the mandible (see Fig. 21.20).
- Identify the junction of the posterior division of the retromandibular vein with the posterior auricular vein, forming the external jugular vein.
- Trace the facial vein's drainage into the anterior division of the retromandibular vein, creating the common facial vein, which drains into the internal jugular vein.

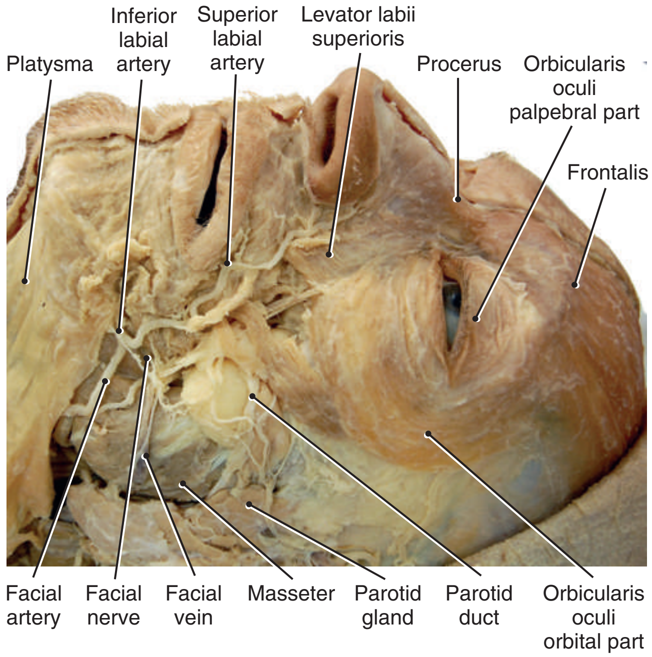

Inferior labial artery
Superior labial artery
Levator labii superioris
Platysma
Procerus
Orbicularis oculi palpebral part
Frontalis
Facial artery
Facial nerve
Facial vein
Masseter
Parotid gland
Parotid duct
Orbicularis oculi orbital part

Fig. 21.29 Anterolateral view of face and neck with skin and subcutaneous tissue removed.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

Trigeminal nerve branches (cutaneous)

- ☐ Supratrochlear nerve
- ☐ Supraorbital nerve
- ☐ Zygomaticotemporal nerve
- ☐ Zygomaticofacial nerve
- ☐ Auriculotemporal nerve
- ☐ Infratrochlear nerve
- ☐ Infraorbital nerve
- ☐ Mental nerve

Facial nerve branches (motor)

- ☐ Facial nerve trunk (deep within parotid gland)
- ☐ Temporal branches
- ☐ Zygomatic branches
- ☐ Buccal branches
- ☐ Marginal mandibular branches
- ☐ Cervical branches

ARTERIES

- ☐ External carotid (within parotid gland)
- ☐ Superficial temporal
- ☐ Maxillary
- ☐ Transverse facial
- ☐ Facial
  - ☐ Superior labial
  - ☐ Inferior labial
  - ☐ Angular

VEINS

- ☐ Facial
- ☐ Angular
- ☐ Retromandibular (within parotid gland)

MUSCLES

- ☐ Occipitofrontalis
  - ☐ Frontalis belly
  - ☐ Galea aponeurotica
  - ☐ Occipitalis belly
- ☐ Procerus
- ☐ Orbicularis oculi
  - ☐ Orbital part
  - ☐ Palpebral part
  - ☐ Lacrimal part
- ☐ Levator labii superioris alaeque nasi
- ☐ Levator labii superioris
- ☐ Levator anguli oris
- ☐ Risorius
- ☐ Zygomaticus major/minor
- ☐ Buccinator
- ☐ Orbicularis oris
- ☐ Depressor anguli oris
- ☐ Depressor labii inferioris
- ☐ Mentalis
- ☐ Platysma

BONES

- ☐ Frontal
- ☐ Zygomatic
- ☐ Temporal
- ☐ Maxillary
- ☐ Mandible

GLAND

- ☐ Parotid
  - ☐ Parotid duct (Stensen’s duct)

CHAPTER 22 INFRATEMPORAL FOSSA

ATLAS REFERENCES

Netter: 9, 10, 55–62, 64, 81–84
McMinn: 42, 44, 76
Gray's Atlas: 507, 527–533

BEFORE YOU BEGIN

- The infratemporal fossa dissection requires the use of an electric saw or a hammer and chisel. Make sure that you wear eye protection when you use these tools.
- Cut the terminal branches of the facial nerve, and reflect the nerves posteriorly toward the parotid gland (Fig. 22.1).
- Similarly, cut the parotid duct as it penetrates the buccinator muscle (Fig. 22.2), and reflect it posteriorly toward the parotid gland (see Fig. 22.1).
- Palpate the zygomatic arch, and expose it from the surrounding adipose tissue and temporal fascia (Fig. 22.3).

DISSECTION STEPS

○ **Identify the temporalis muscle, and trace its course medial to the zygomatic arch (Fig. 22.4).**

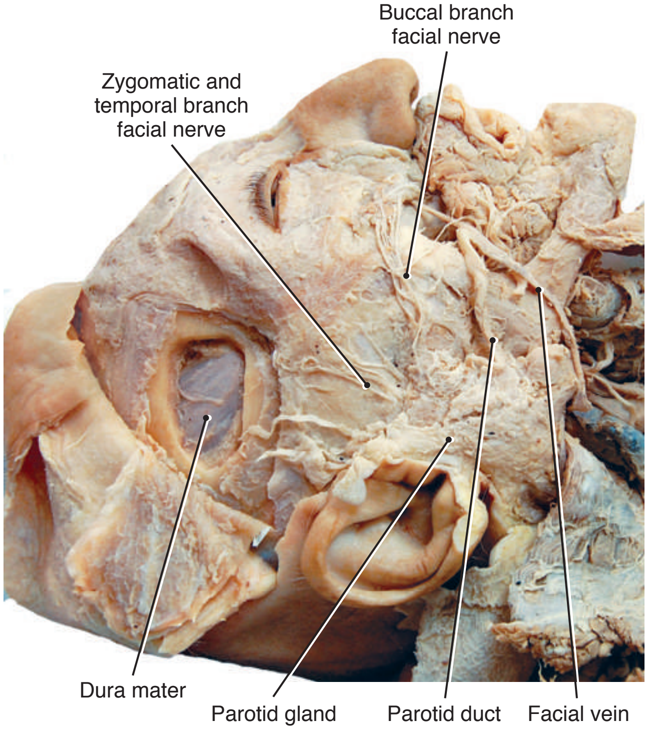

Buccal branch facial nerve
Zygomatic and temporal branch facial nerve
Dura mater
Parotid gland
Parotid duct
Facial vein

Fig. 22.2 Lateral view of face with skin reflected, revealing superficial structures.

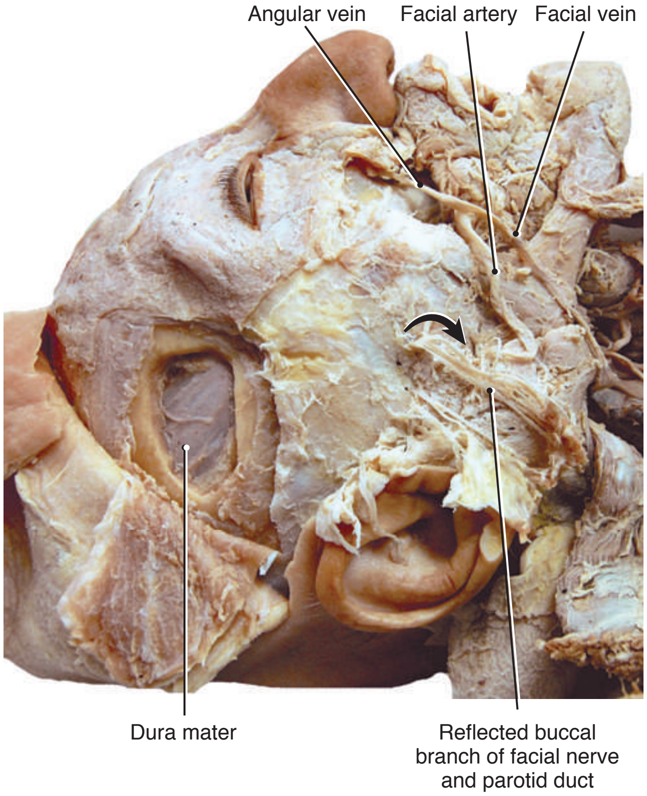

Angular vein
Facial artery
Facial vein
Dura mater
Reflected buccal branch of facial nerve and parotid duct

Fig. 22.1 Lateral view of face, with parotid duct and branches of facial nerve reflected.

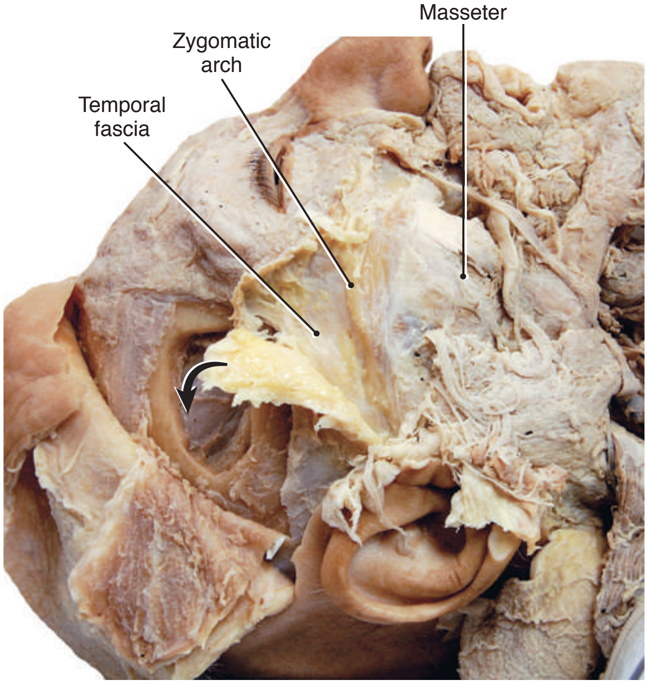

Masseter
Zygomatic arch
Temporal fascia

Fig. 22.3 Lateral view of face, with skin and subcutaneous tissue removed and temporal fascia reflected.

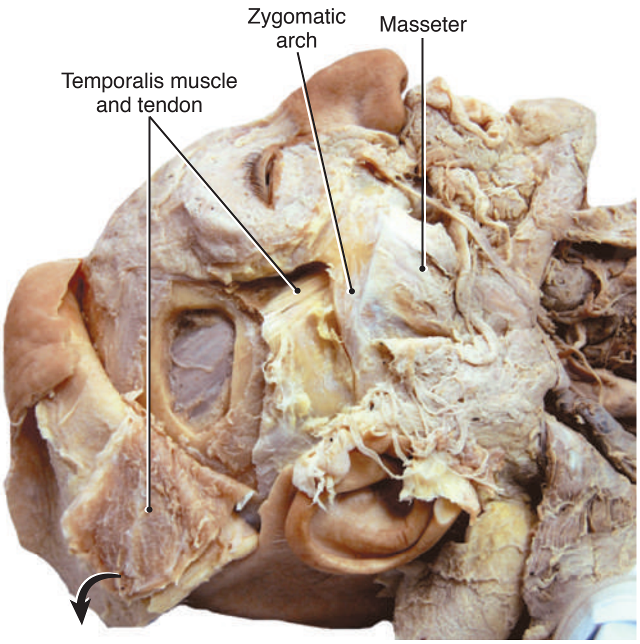

Zygomatic arch
Masseter
Temporalis muscle and tendon

Fig. 22.4 Lateral view of face, with skin, subcutaneous tissue, and temporal fascia removed.

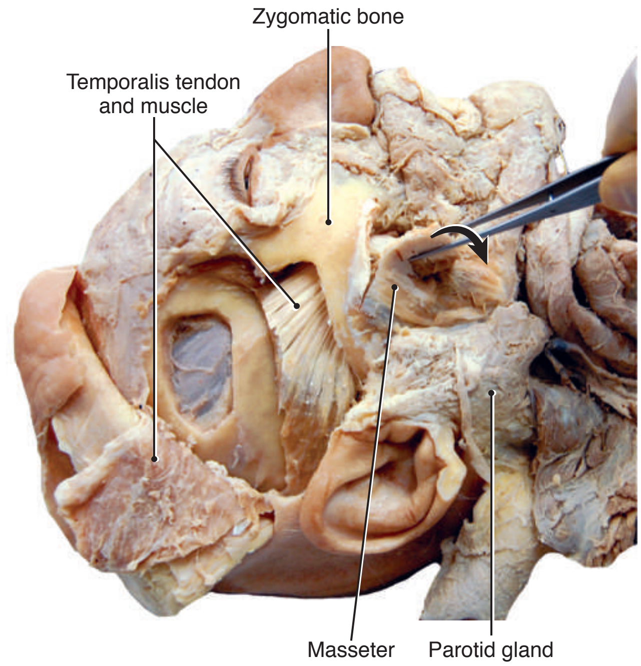

Zygomatic bone
Temporalis tendon and muscle
Masseter
Parotid gland

Fig. 22.6 Reflection of masseter muscle from inferior border of zygomatic arch.

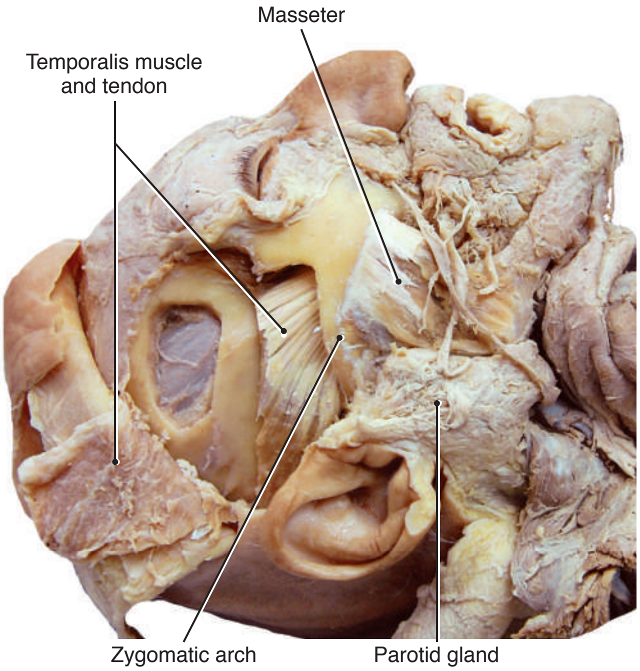

Masseter
Temporalis muscle and tendon
Zygomatic arch
Parotid gland

Fig. 22.5 Lateral view with skin and subcutaneous tissue removed.

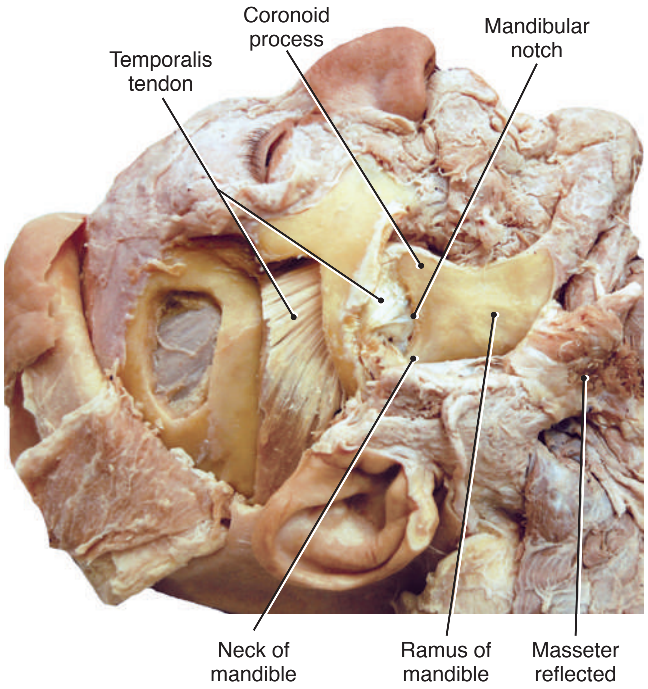

Coronoid process
Mandibular notch
Temporalis tendon
Neck of mandible
Ramus of mandible
Masseter reflected

Fig. 22.7 Lateral view of face with superficial skin and subcutaneous skin removed and masseter muscle reflected.

- **Clean the lateral surface of the masseter muscle, and expose its borders (Fig. 22.5).**
- **Detach the masseter muscle from the inferior border of the zygomatic arch (Fig. 22.6), and reflect it inferiorly toward the angle of the mandible.**
- **Clean the remaining soft tissues over the mandible, and expose its surface (Fig. 22.7).**
- **Identify the temporal, zygomatic, and mandibular bony regions.**
- **Just deep to the anterior border of the ramus of the mandible, in the fat and connective tissue of the anterior edge of the temporalis muscle, identify and clean the *buccal nerve,* a branch of the mandibular division (V3) of the trigeminal nerve.**
- **Place scissors or a probe underneath the zygomatic arch.**
- **Using a saw, cut the zygomatic arch just anterior to the attachment of the masseter muscle (Fig. 22.8).**

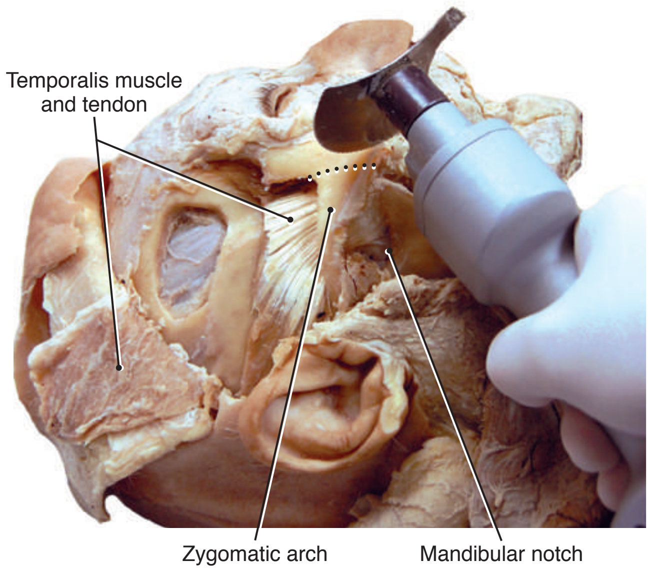

Temporalis muscle and tendon
Zygomatic arch
Mandibular notch

Fig. 22.8 Saw cut of zygomatic arch just anterior to attachment of masseter muscle.

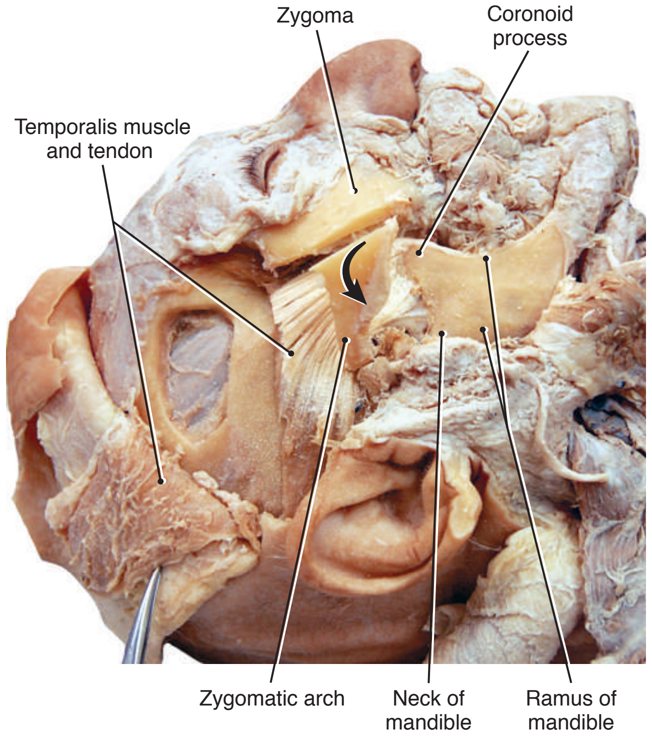

Zygoma
Coronoid process
Temporalis muscle and tendon
Zygomatic arch
Neck of mandible
Ramus of mandible

Fig. 22.9 Lateral view of face, revealing zygomatic arch osteotomy anterior to masseter attachment, with a second cut anterior to temporomandibular joint.

- Make a second cut through the arch just posterior to the masseter and anterior to the temporomandibular joint (Fig. 22.9).
- Detach the cut piece of zygomatic bone (Fig. 22.10).
- With scissors, cut the *temporalis muscle* from the coronoid process and ramus of the mandible (Fig. 22.11).
- Reflect the temporalis upward, and clean the soft tissues and fat over the mandibular notch (Fig. 22.12).

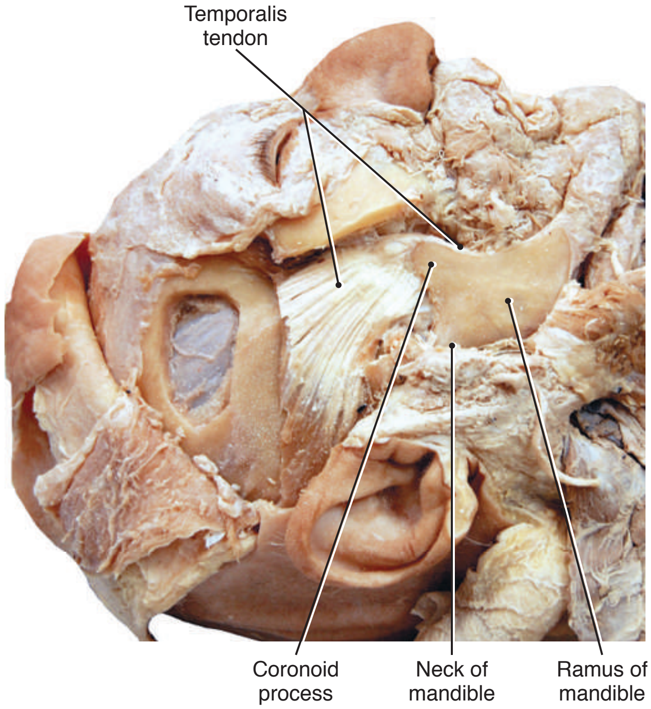

Temporalis tendon
Coronoid process
Neck of mandible
Ramus of mandible

Fig. 22.10 Removal of zygomatic arch, exposing attachments of temporalis muscle and bony landmarks of mandible.

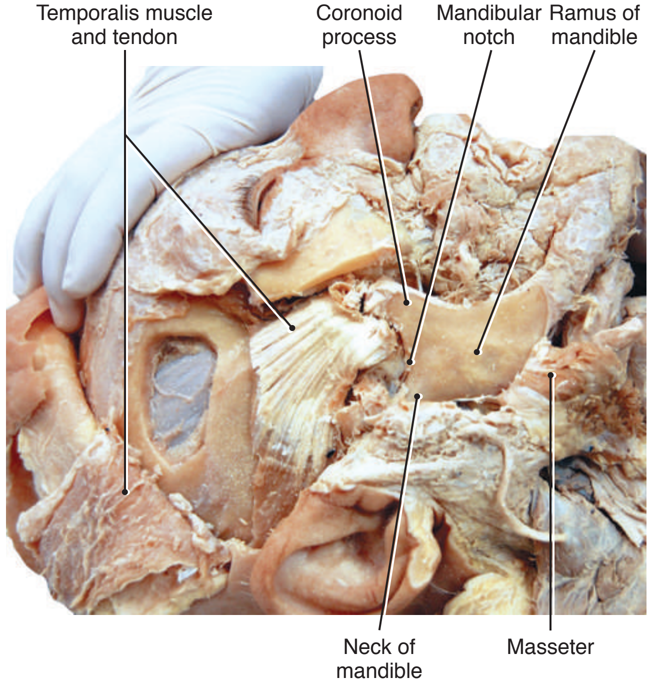

Temporalis muscle and tendon
Coronoid process
Mandibular notch
Ramus of mandible
Neck of mandible
Masseter

Fig. 22.11 Detachment of temporalis muscle from coronoid process and mandibular notch.

- Place your scissors or a probe or scalpel handle immediately beneath the ramus of the mandible (Fig. 22.13).
- Push the soft tissues, musculature, and vessels inferiorly.

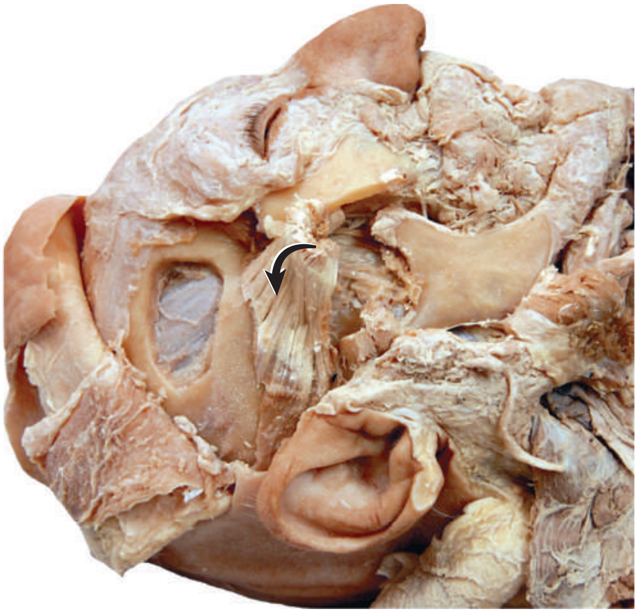


Fig. 22.12 Reflection of temporalis muscle upward *(arrow)*.

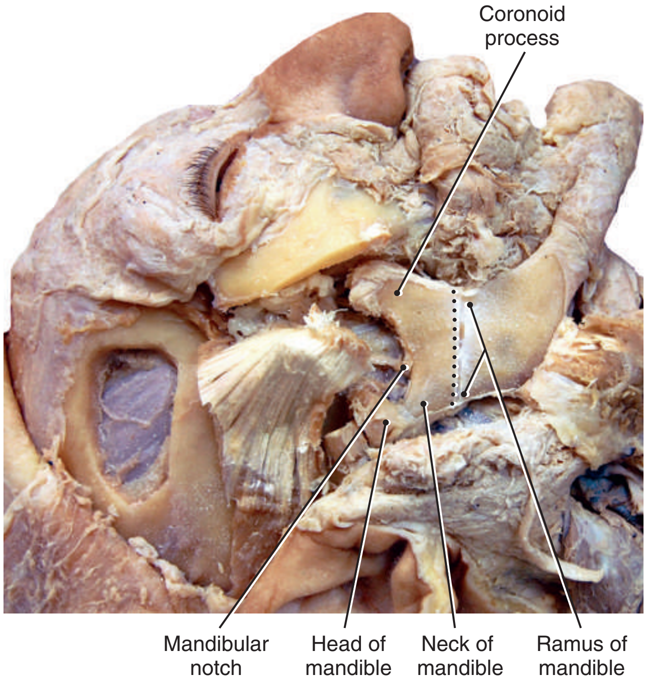

Coronoid process
Mandibular notch
Head of mandible
Neck of mandible
Ramus of mandible

Fig. 22.14 Saw cut horizontally through ramus of mandible below coronoid process.

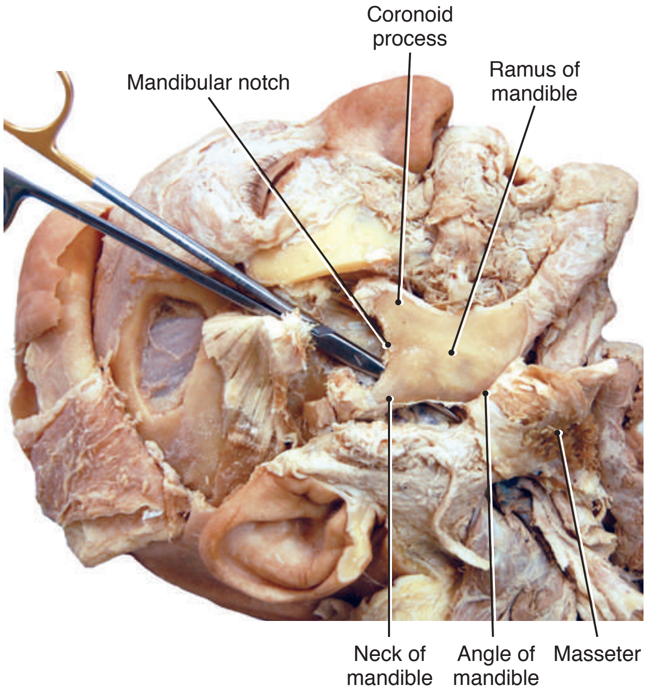

Mandibular notch
Coronoid process
Ramus of mandible
Neck of mandible
Angle of mandible
Masseter

Fig. 22.13 Placing scissors underneath the ramus of mandible and pushing soft tissues, muscles, and vessels inferiorly preserves underlying structure when the mandible is cut with electric saw.

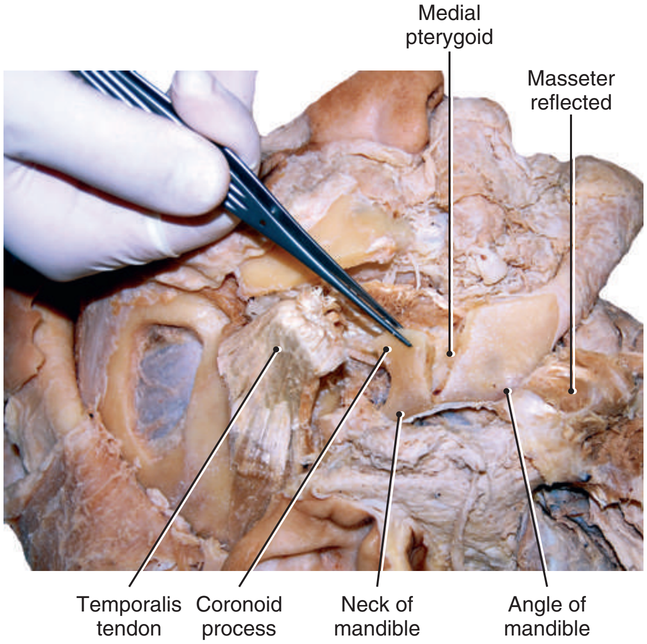

Medial pterygoid
Masseter reflected
Temporalis tendon
Coronoid process
Neck of mandible
Angle of mandible

Fig. 22.15 Severed coronoid process and the temporalis muscle reflected superiorly to open up dissection area.

DISSECTION **TIP**

This maneuver (see Fig. 22.13) is important for preserving underlying structures when the mandible is cut. You may leave the probe or scissors in place to protect the inferior alveolar neurovascular bundle and lingual nerve when you perform the cut (see next step).

- **With an electric saw, cut horizontally through the ramus of the mandible 2 to 3 inches (5–7.5 cm) below the coronoid process, leaving the articular process in place (Fig. 22.14).**
- **Reflect the severed coronoid process and the temporalis muscle superiorly (Figs. 22.15 to 22.17).**

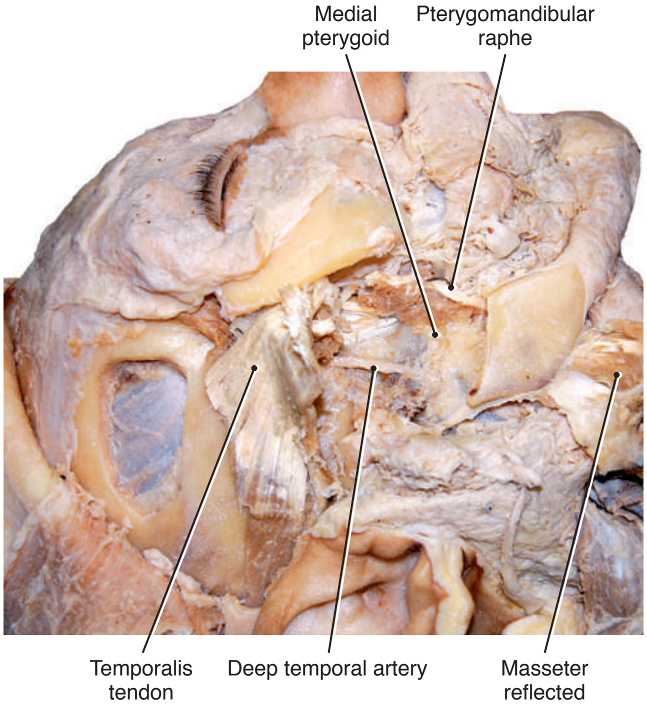

Medial pterygoid
Pterygomandibular raphe
Temporalis tendon
Deep temporal artery
Masseter reflected

Fig. 22.16 Appreciate medial pterygoid muscle with all soft tissues removed.

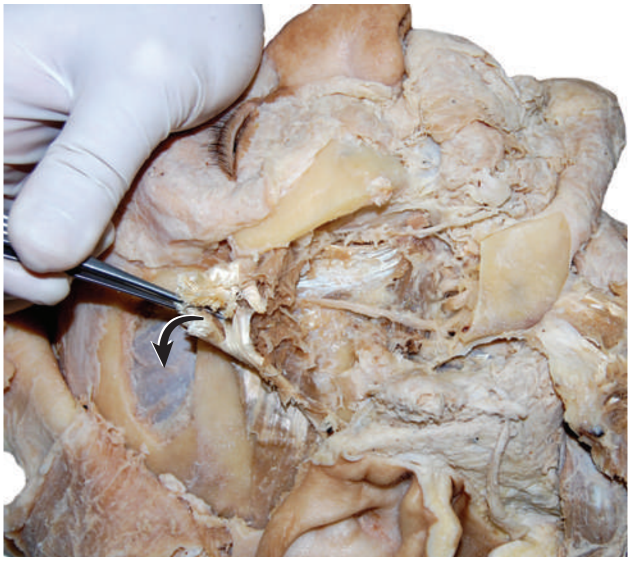


Fig. 22.17 Further reflection of temporalis muscle to expose contents of the infratemporal fossa.

DISSECTION **TIP**

Take special care when you reflect the coronoid process and the temporalis muscle so as not to injure the buccal nerve.

- As the temporalis is reflected superiorly, observe the deep temporal arteries supplying this muscle.

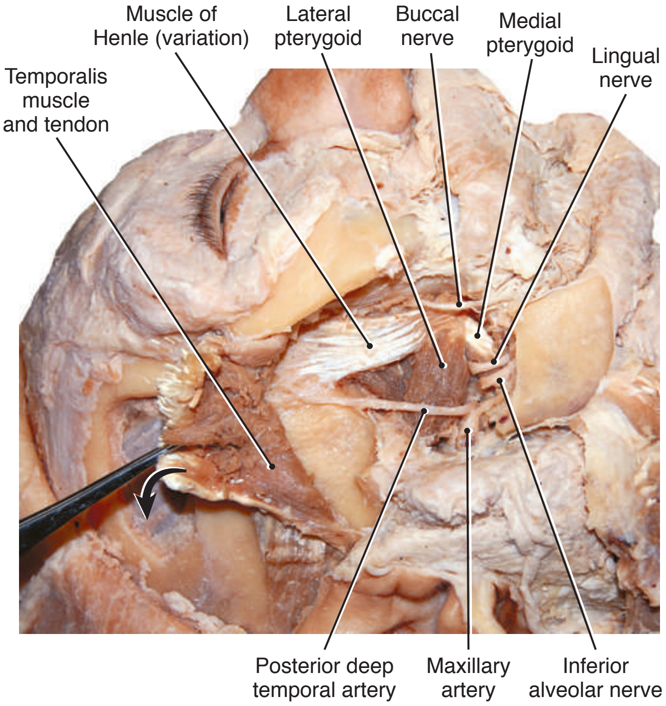

Muscle of Henle (variation)
Lateral pterygoid
Buccal nerve
Medial pterygoid
Lingual nerve
Temporalis muscle and tendon
Posterior deep temporal artery
Maxillary artery
Inferior alveolar nerve

Fig. 22.18 Appreciate medial and lateral pterygoid muscles. The maxillary artery is located deep to lateral pterygoid in this specimen; note also the uncommon pterygoideus proprius (muscle of Henle).

DISSECTION **TIP**

You can choose either to sever the arteries or to keep them. In this dissection, we choose to keep the deep temporal vessels (see Figs. 22.16 and 22.17).

- Once temporalis has been reflected, identify the medial pterygoid muscle (see Figs. 22.15 to 22.17).
- Once the temporalis muscle is reflected and the soft tissues are cleaned, identify and expose the *lateral pterygoid muscle,* which lies just beneath the temporalis (Fig. 22.18).

ANATOMY **NOTE**

The lateral pterygoid muscle arises from the lateral pterygoid plate and passes horizontally to insert onto the articular disc of the temporomandibular joint (see Fig. 22.18).

ANATOMY **NOTE**

In some cadavers, a variant muscle may be seen in the infratemporal fossa. In this specimen, a pterygoideus proprius was identified (muscle of Henle). This muscle originates from the anterior infratemporal crest, runs vertically downward to insert onto the lateral pterygoid plate, and crosses superficially to the lateral pterygoid muscle (see Fig. 22.18). Typically, the muscle of Henle has no functional significance, but it may compress the mandibular nerve, resulting in possible trigeminal neuralgia.

- Clean the soft tissues and fat at the inferior border of the lateral pterygoid muscle (Fig. 22.19 and Plate 22.1).
- Identify the *inferior alveolar nerve* and inferior alveolar artery superficial to the medial pterygoid muscle (see Figs. 22.18 and 22.19).
- Clean the inferior alveolar nerve and trace it to the mandibular foramen.

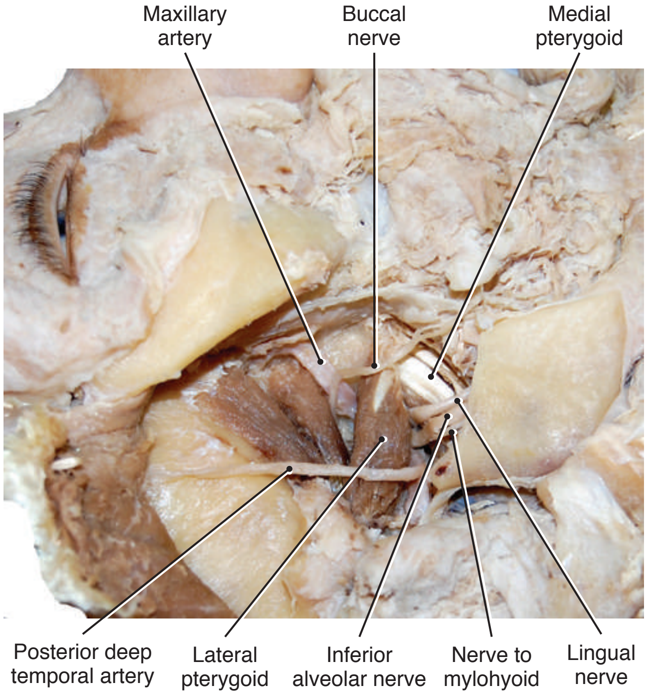

Maxillary artery
Buccal nerve
Medial pterygoid
Posterior deep temporal artery
Lateral pterygoid
Inferior alveolar nerve
Nerve to mylohyoid
Lingual nerve

Fig. 22.19 Soft tissue in space between medial and lateral pterygoid muscles cleaned, exposing key structures.

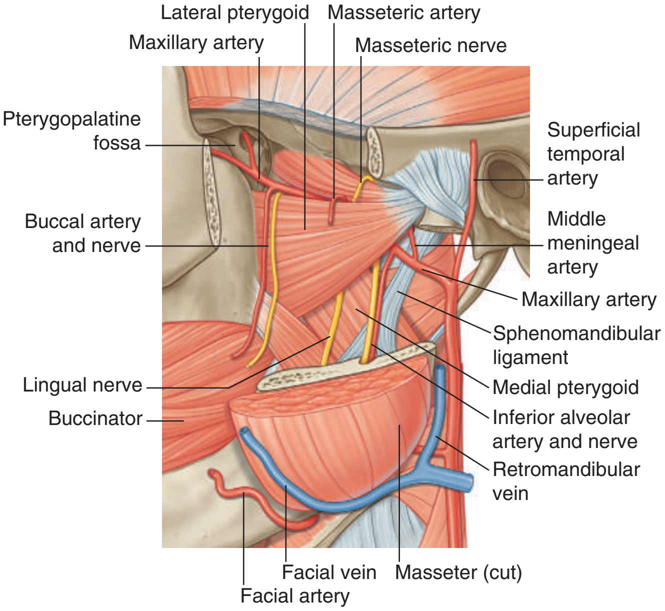

Lateral pterygoid
Masseteric artery
Maxillary artery
Masseteric nerve
Pterygopalatine fossa
Superficial temporal artery
Buccal artery and nerve
Middle meningeal artery
Maxillary artery
Sphenomandibular ligament
Lingual nerve
Medial pterygoid
Buccinator
Inferior alveolar artery and nerve
Retromandibular vein
Facial vein
Masseter (cut)
Facial artery

Plate 22.1 Nerves and vessels of the infratemporal fossa.

- Look at the lateral surface of the inferior alveolar nerve, and note the small branch that runs parallel with it, the nerve to the mylohyoid muscle (see Fig. 22.19).

ANATOMY **NOTE**

The nerve to the mylohyoid arises just before the inferior alveolar nerve enters the mandibular foramen. The nerve to the mylohyoid travels inferiorly, beneath the ramus and body of the mandible, to innervate the mylohyoid muscle and the anterior belly of the digastric muscle.

- Lateral to the inferior alveolar nerve, identify the *lingual nerve* (Figs. 22.20 and 22.21).
- Medial to the inferior alveolar nerve, identify the *buccal nerve.*
- Immediately underneath these nerves, observe the medial pterygoid muscle passing from the pterygoid plate to its insertion onto the inferior and posterior parts of the medial surface of the mandibular ramus.
- Identify and expose the maxillary artery (see Fig. 22.19 to 22.21 and see Fig. 22.29).

ANATOMY **NOTE**

In the majority of cadavers, the lateral pterygoid muscle is crossed superficially by branches of the maxillary artery; in the remaining specimens, the artery travels deep to the muscle (see Fig. 22.21).

- Proceed by carefully detaching the lateral pterygoid muscle from its origin on the pterygoid plate with scissors and forceps (Figs. 22.22 to 22.24).

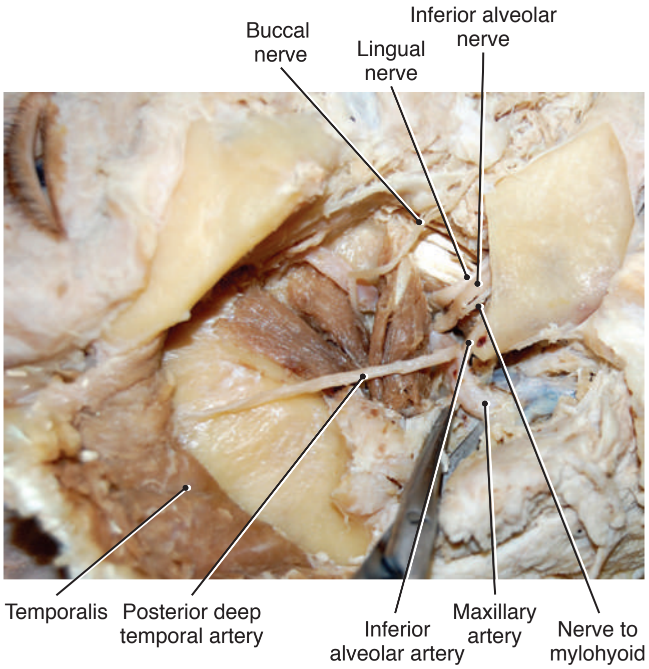

Buccal nerve
Lingual nerve
Inferior alveolar nerve
Temporalis
Posterior deep temporal artery
Inferior alveolar artery
Maxillary artery
Nerve to mylohyoid

Fig. 22.20 The maxillary artery is exposed.

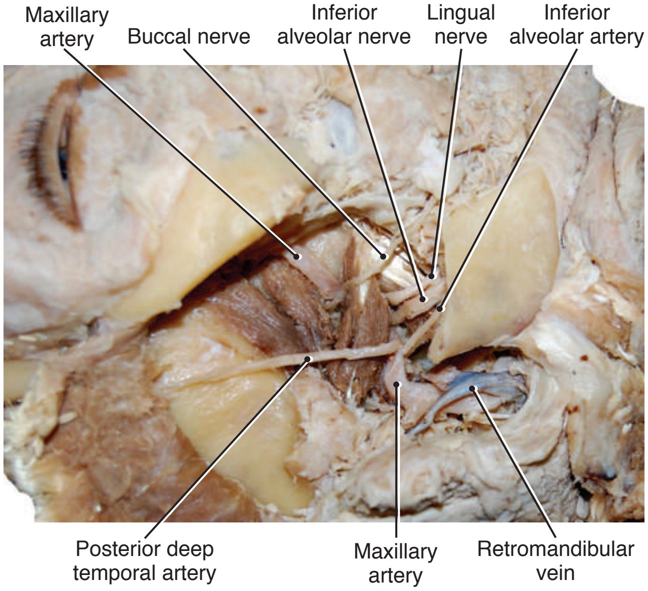

Maxillary artery
Buccal nerve
Inferior alveolar nerve
Lingual nerve
Inferior alveolar artery
Posterior deep temporal artery
Maxillary artery
Retromandibular vein

Fig. 22.21 Further exposure of the maxillary artery and accompanying maxillary and retromandibular veins.

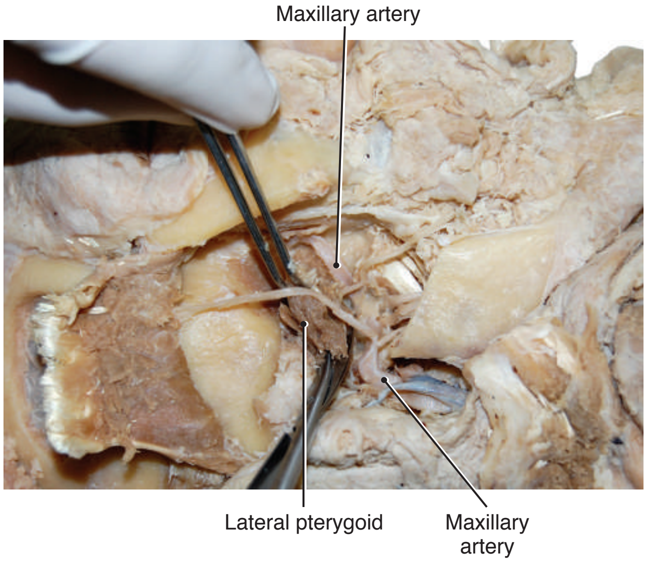

Maxillary artery
Lateral pterygoid
Maxillary artery

Fig. 22.22 Lateral pterygoid muscle removed with scissors and forceps.

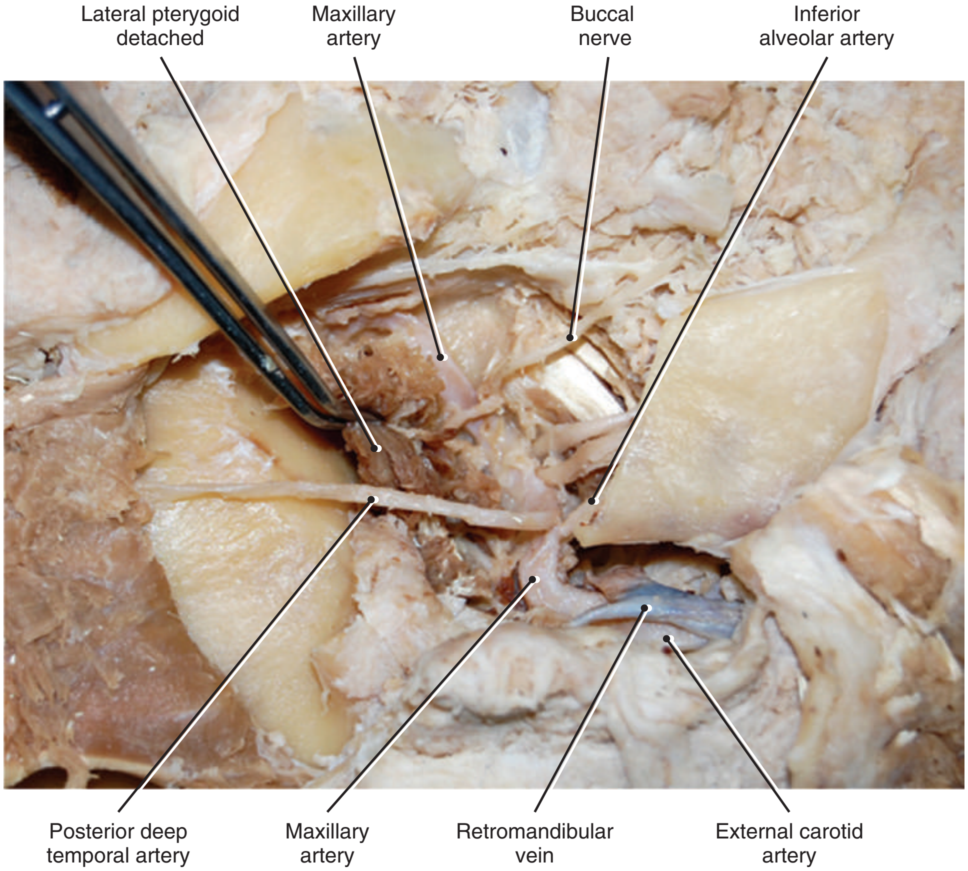

Lateral pterygoid detached
Maxillary artery
Buccal nerve
Inferior alveolar artery
Posterior deep temporal artery
Maxillary artery
Retromandibular vein
External carotid artery

Fig. 22.23 Removal of remaining lateral pterygoid muscle fibers.

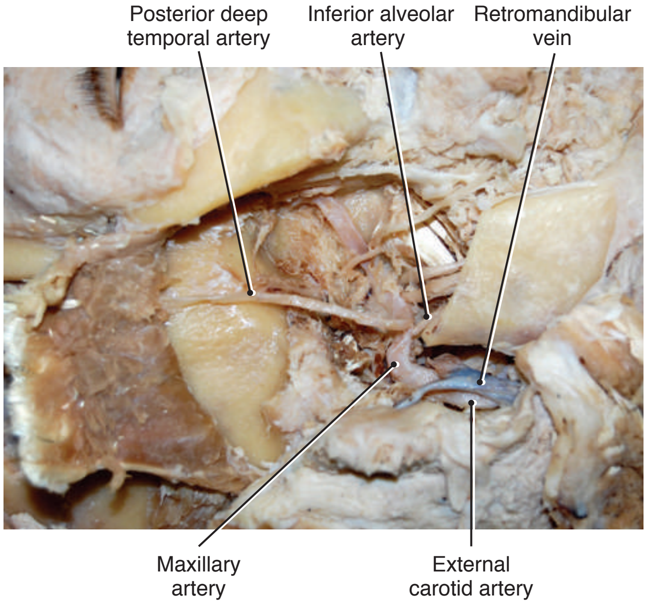

Posterior deep temporal artery
Inferior alveolar artery
Retromandibular vein
Maxillary artery
External carotid artery

Fig. 22.24 Complete removal of lateral pterygoid muscle. Note soft tissues around maxillary artery; carefully remove all soft tissues.

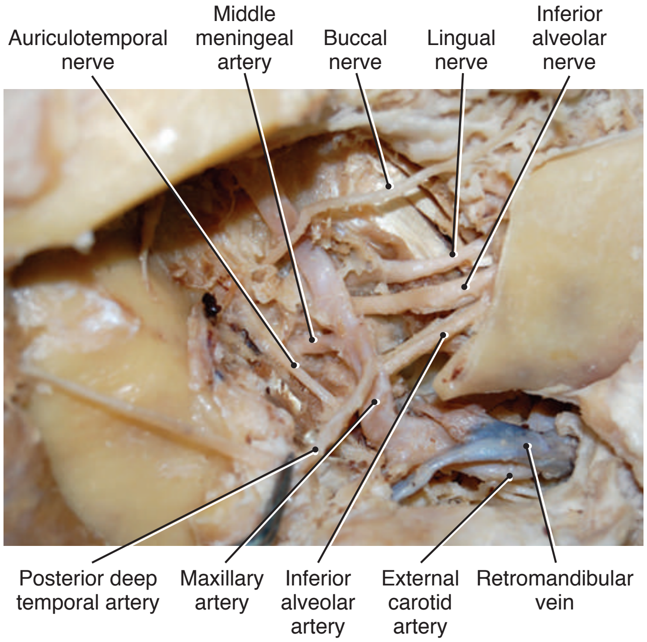

Auriculotemporal nerve
Middle meningeal artery
Buccal nerve
Lingual nerve
Inferior alveolar nerve
Posterior deep temporal artery
Maxillary artery
Inferior alveolar artery
External carotid artery
Retromandibular vein

Fig. 22.25 Complete removal of soft tissues, revealing neurovascular structures.

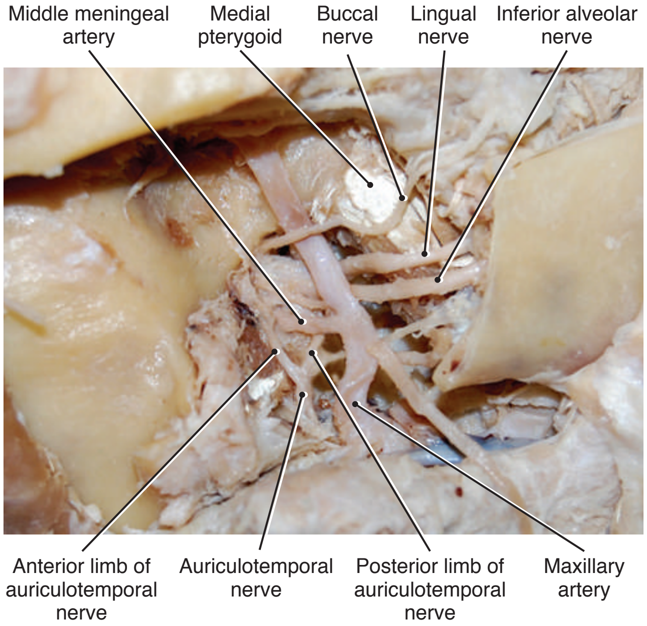

Middle meningeal artery
Medial pterygoid
Buccal nerve
Lingual nerve
Inferior alveolar nerve
Anterior limb of auriculotemporal nerve
Auriculotemporal nerve
Posterior limb of auriculotemporal nerve
Maxillary artery

Fig. 22.26 Lateral view of infratemporal fossa, revealing medial pterygoid muscle and neurovascular structures.

DISSECTION **TIP**

Removing the lateral pterygoid muscle can be a challenge. Be patient, and detach its muscle fibers carefully, paying special attention to the branches of the maxillary artery underneath it (see Figs. 22.22 through 22.24).

- Carefully remove all soft tissues around the maxillary artery.
- Posterior to the inferior alveolar artery and nerve and anterior to the medial pterygoid muscle, identify the sphenomandibular ligament.

DISSECTION **TIP**

This ligament is thin and may resemble a nerve, and it is often confused with the inferior alveolar nerve.

- Once the lateral pterygoid muscle is removed, expose the maxillary artery and its branches (Fig. 22.25).
- Note the retromandibular vein formed by the junction of the superficial temporal and maxillary veins (see Fig. 22.25).
- Identify the middle meningeal artery, which typically runs vertically toward the sphenoid bone, to enter the foramen spinosum (see Figs. 22.25 and 22.27).
- Identify the two roots of the auriculotemporal nerve, which, in the majority of cases, you will find encircling the middle meningeal artery (Figs. 22.26 and 22.27 and Plates 22.2 and 22.3).
- Lift the lingual nerve, and trace it superiorly until you see it joined on its posterior surface by a small nerve, the *chorda tympani,* which is a branch of the

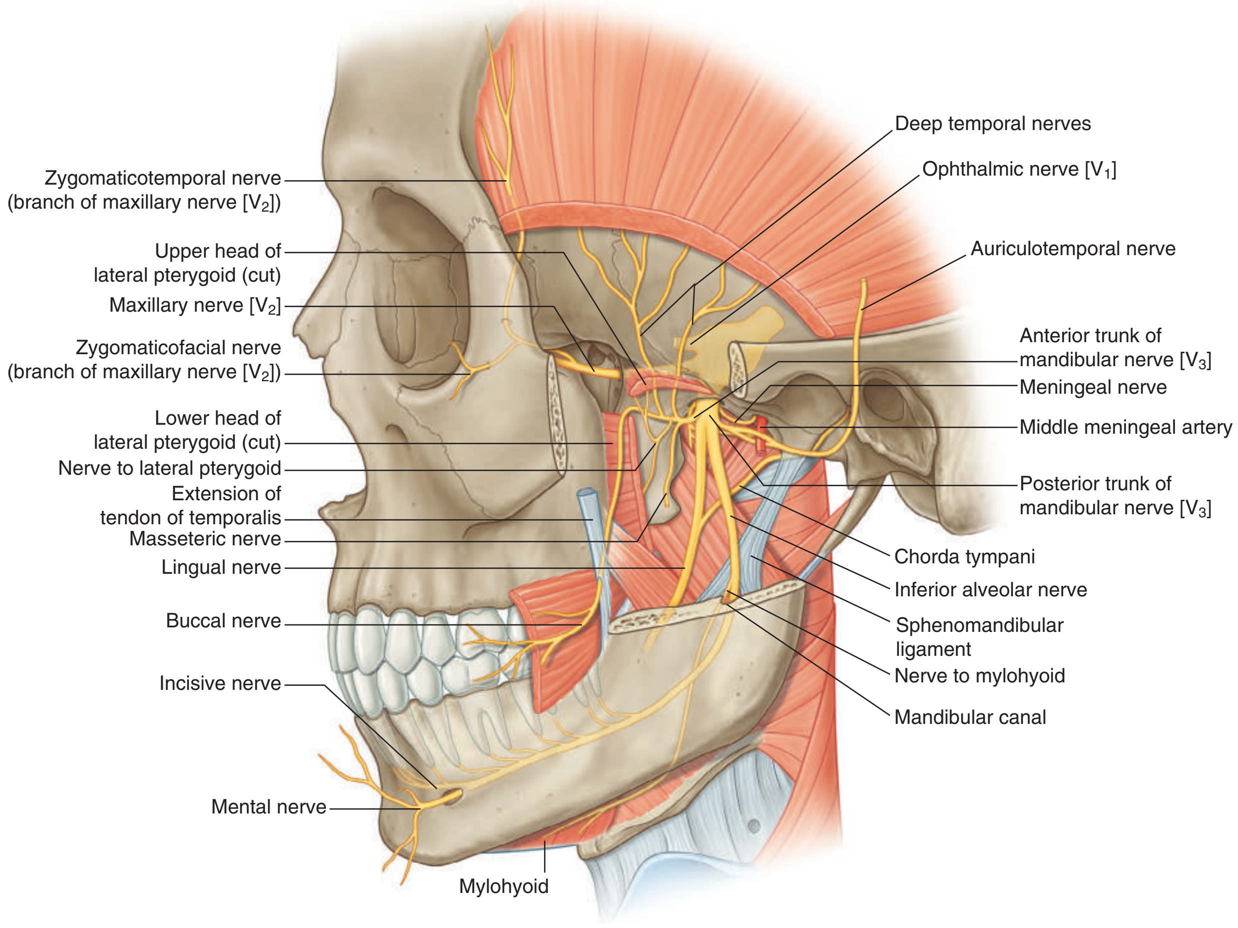

Zygomaticotemporal nerve (branch of maxillary nerve [V2])
Upper head of lateral pterygoid (cut)
Maxillary nerve [V2]
Zygomaticofacial nerve (branch of maxillary nerve [V2])
Lower head of lateral pterygoid (cut)
Nerve to lateral pterygoid
Extension of tendon of temporalis
Masseteric nerve
Lingual nerve
Buccal nerve
Incisive nerve
Mental nerve
Mylohyoid
Deep temporal nerves
Ophthalmic nerve [V1]
Auriculotemporal nerve
Anterior trunk of mandibular nerve [V3]
Meningeal nerve
Middle meningeal artery
Posterior trunk of mandibular nerve [V3]
Chorda tympani
Inferior alveolar nerve
Sphenomandibular ligament
Nerve to mylohyoid
Mandibular canal

Plate 22.2 Nerves of the infratemporal fossa.

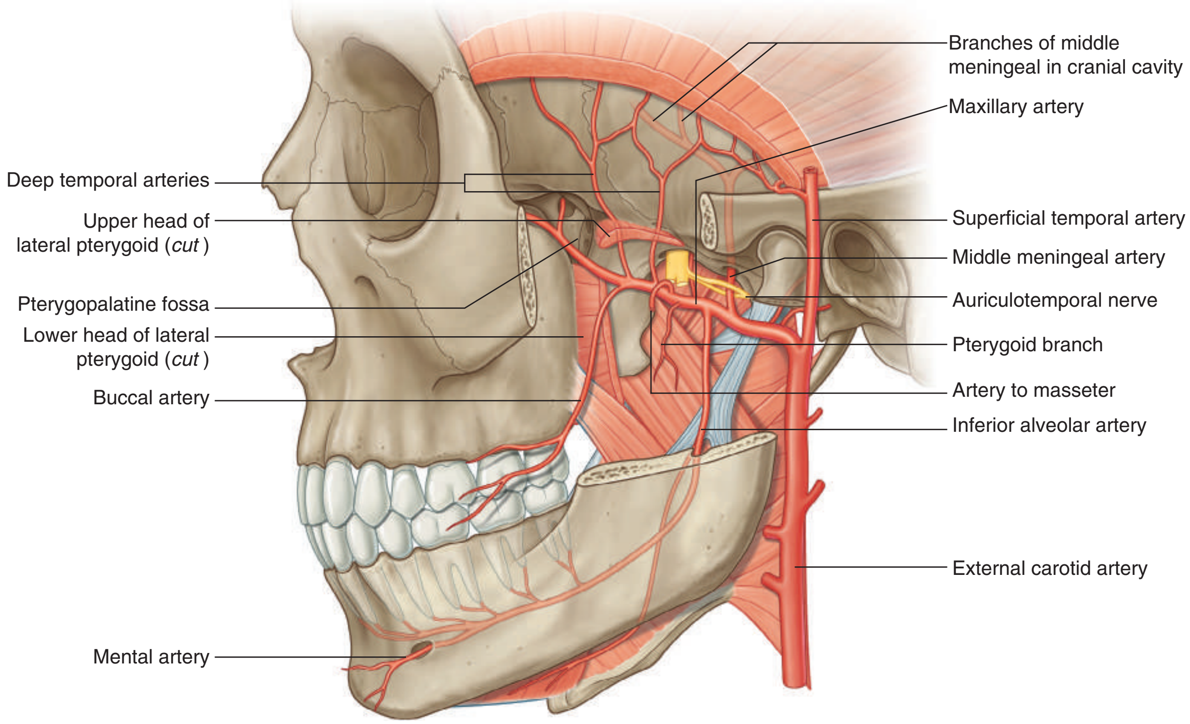

Deep temporal arteries
Upper head of lateral pterygoid (cut)
Pterygopalatine fossa
Lower head of lateral pterygoid (cut)
Buccal artery
Mental artery
Branches of middle meningeal in cranial cavity
Maxillary artery
Superficial temporal artery
Middle meningeal artery
Auriculotemporal nerve
Pterygoid branch
Artery to masseter
Inferior alveolar artery
External carotid artery

Plate 22.3 Arteries of the temporal and infratemporal fossae.

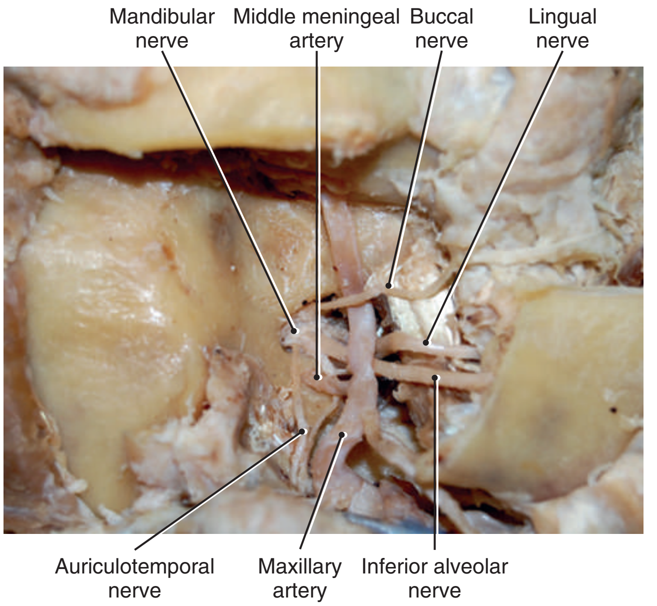

Mandibular nerve
Middle meningeal artery
Buccal nerve
Lingual nerve
Auriculotemporal nerve
Maxillary artery
Inferior alveolar nerve

Fig. 22.27 Lateral view of infratemporal fossa, revealing the medial pterygoid muscle and neurovascular structures.

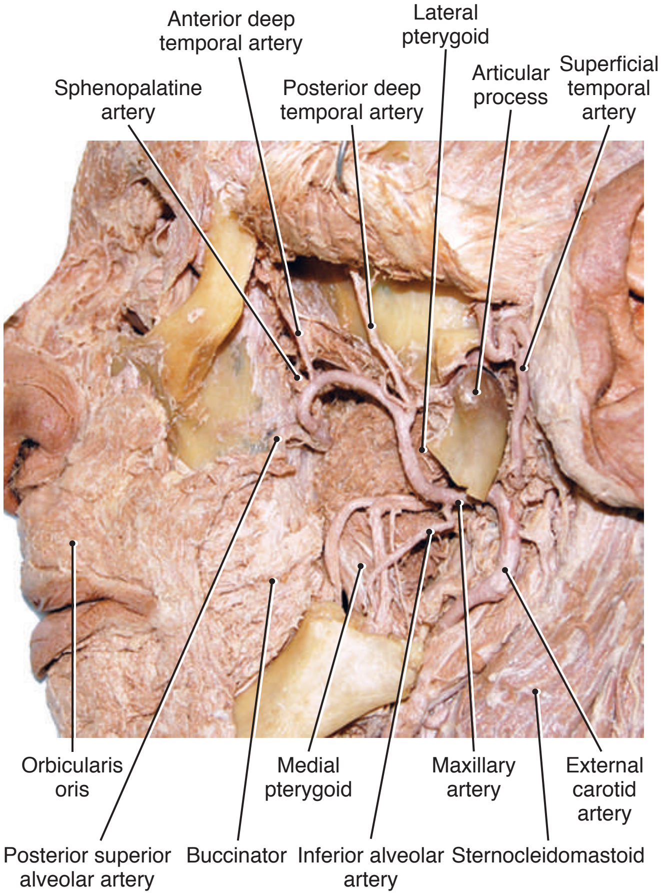
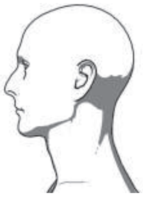

Anterior deep temporal artery
Lateral pterygoid
Sphenopalatine artery
Posterior deep temporal artery
Articular process
Superficial temporal artery
Orbicularis oris
Medial pterygoid
Maxillary artery
External carotid artery
Posterior superior alveolar artery
Buccinator
Inferior alveolar artery
Sternocleidomastoid

Fig. 22.29 A different specimen, with branches of maxillary artery exposed superficial to lateral pterygoid muscle.



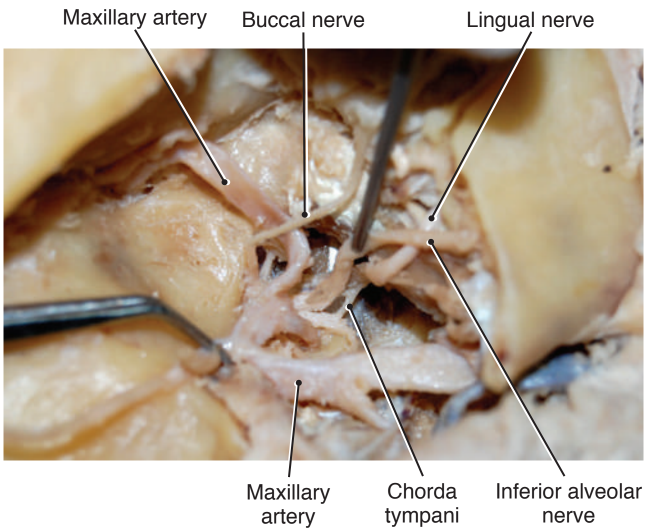

Maxillary artery
Buccal nerve
Lingual nerve
Maxillary artery
Chorda tympani
Inferior alveolar nerve

Fig. 22.28 Lingual nerve lifted and followed posteriorly to its connection with chorda tympani nerve.

facial nerve (Fig. 22.28). If this nerve is not evident, clean the soft tissue around the lingual nerve more posteriorly.

- Clean the lingual and inferior alveolar nerves, and trace their passage deep to the medial pterygoid muscle.
- Deep to the infratemporal fossa, trace and follow the termination of the maxillary artery, the *sphenopalatine artery,* toward the sphenopalatine foramen (Figs. 22.29 and 22.30).
- Typically, two additional branches are easily identifiable. Identify the *infraorbital artery* as it ascends to enter the infraorbital canal, and the *posterior superior alveolar artery* as it descends to enter the infratemporal surface of the maxilla (see Fig. 22.30).
- Identify the mandibular canal and the inferior alveolar nerve (Figs. 22.31 to 22.33).
- With an electric drill, cut the mandible in a direction demarcating a line between the mandibular canal and mental foramen (see Fig. 22.32).
- With fine forceps, lift the small branches of the inferior alveolar nerve terminating on the teeth (Fig. 22.34).
- Using a bone saw, make a shallow parasagittal cut through the temporomandibular joint. Identify the articular disc, the two synovial cavities, and the articular capsule of that joint.

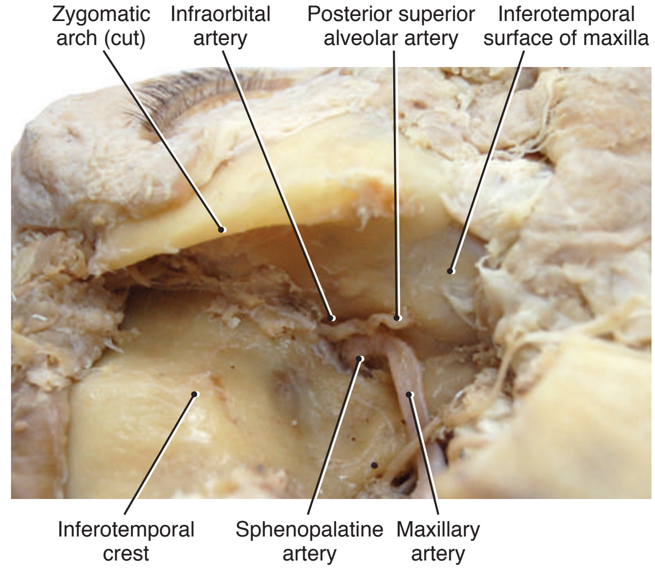

Zygomatic arch (cut)
Infraorbital artery
Posterior superior alveolar artery
Inferotemporal surface of maxilla
Inferotemporal crest
Sphenopalatine artery
Maxillary artery

Fig. 22.30 Deep view of infratemporal fossa, revealing termination of maxillary artery.

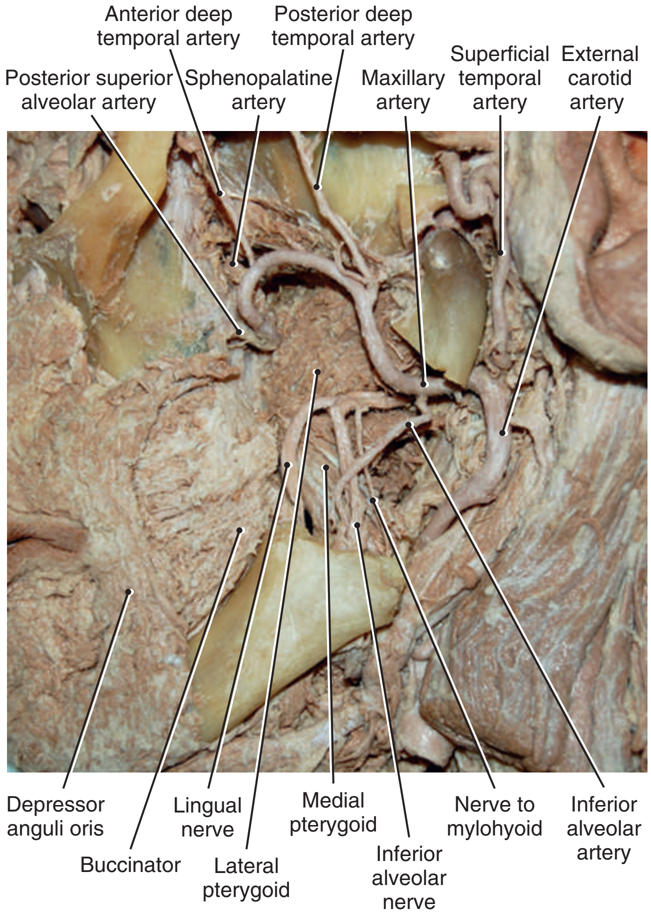
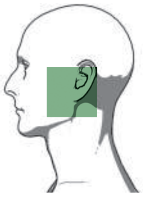

Anterior deep temporal artery
Posterior deep temporal artery
Posterior superior alveolar artery
Sphenopalatine artery
Maxillary artery
Superficial temporal artery
External carotid artery
Depressor anguli oris
Buccinator
Lingual nerve
Lateral pterygoid
Medial pterygoid
Inferior alveolar nerve
Nerve to mylohyoid
Inferior alveolar artery

Fig. 22.31 Lateral view of infratemporal fossa.



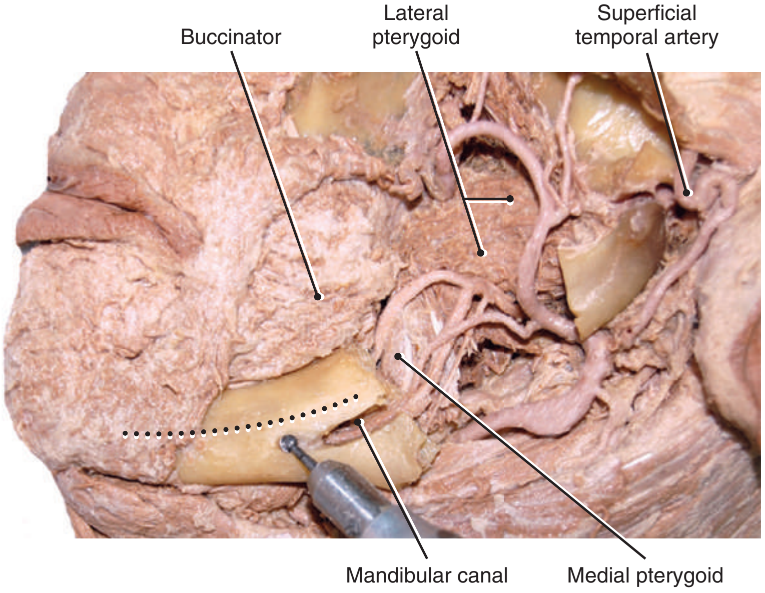
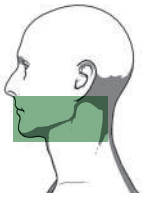

Buccinator
Lateral pterygoid
Superficial temporal artery
Mandibular canal
Medial pterygoid

Fig. 22.32 Mandible drilled in direction demarcated *(broken line)* between mandibular canal and mental foramen.



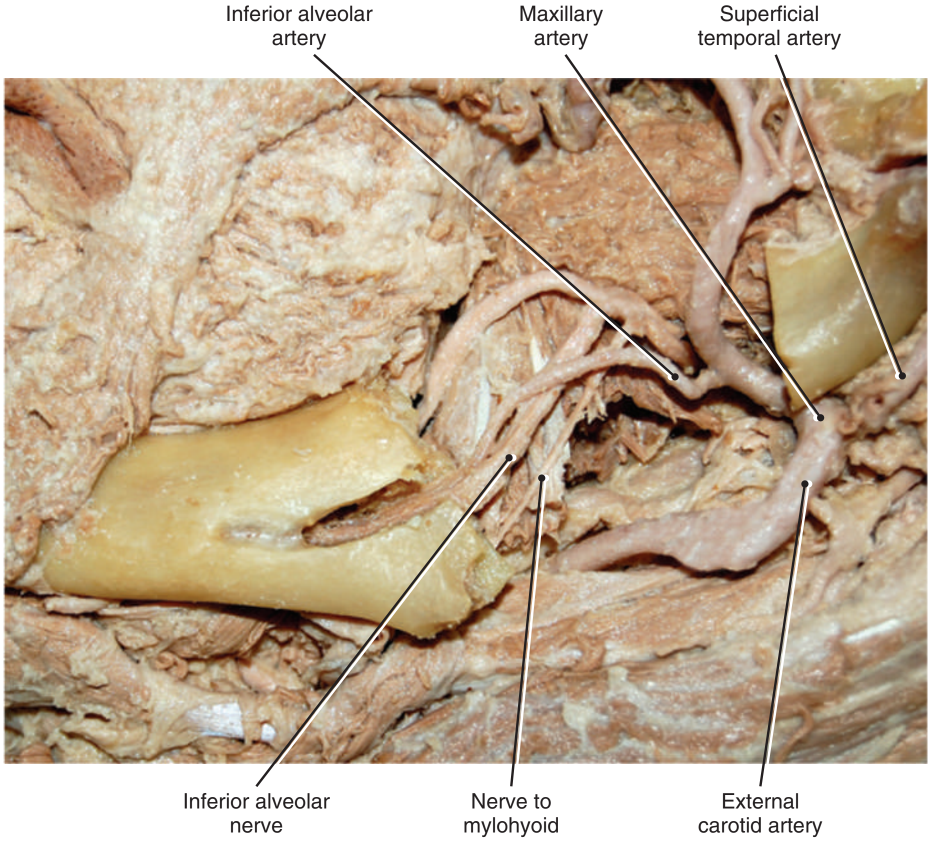
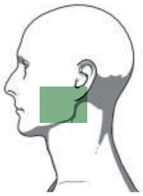

Inferior alveolar artery
Maxillary artery
Superficial temporal artery
Inferior alveolar nerve
Nerve to mylohyoid
External carotid artery

Fig. 22.33 Exposure of contents of mandibular canal.



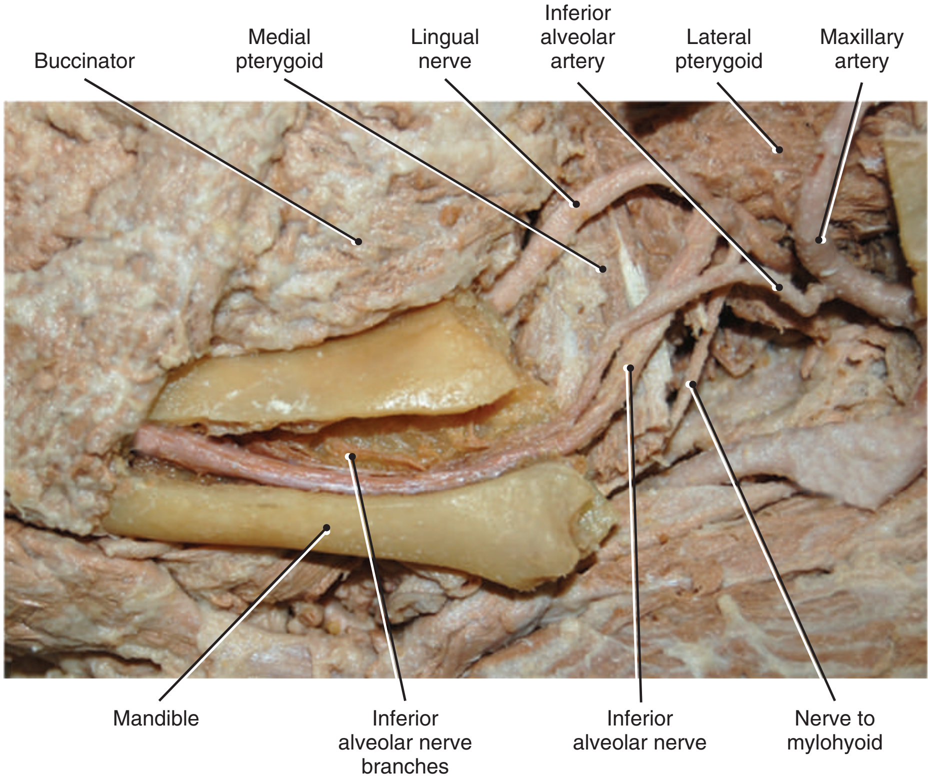
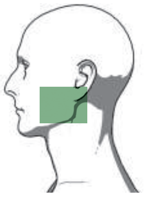

Buccinator
Medial pterygoid
Lingual nerve
Inferior alveolar artery
Lateral pterygoid
Maxillary artery
Mandible
Inferior alveolar nerve branches
Inferior alveolar nerve
Nerve to mylohyoid

Fig. 22.34 Further exposure of inferior alveolar nerve within mandibular canal. Note small branches to the teeth.



LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Trigeminal, mandibular division (V3)
- ☐ Auriculotemporal
- ☐ Inferior alveolar
- ☐ Nerve to mylohyoid
- ☐ Lingual
- ☐ Chorda tympani
- ☐ Buccal (long buccal of trigeminal)

ARTERIES

- ☐ Maxillary
  - ☐ Middle meningeal
  - ☐ Inferior alveolar
  - ☐ Deep temporal arteries
  - ☐ Muscular branches
    - ☐ Masseteric artery
    - ☐ Artery to medial pterygoid
    - ☐ Artery to lateral pterygoid
  - ☐ Sphenopalatine (terminal branch of maxillary artery)
  - ☐ Posterior superior alveolar
  - ☐ Infraorbital
  - ☐ Buccal

VEINS

- ☐ Pterygoid plexus (often difficult to isolate in cadaveric tissue)

MUSCLES

- ☐ Masseter
- ☐ Temporalis
- ☐ Lateral pterygoid
- ☐ Medial pterygoid

BONES

- ☐ Temporal
- ☐ Sphenoid
- ☐ Mandible
  - ☐ Head
  - ☐ Coronoid process
  - ☐ Notch
  - ☐ Ramus
  - ☐ Angle
  - ☐ Neck

CONNECTIVE TISSUE

- ☐ Temporomandibular joint capsule
- ☐ Temporomandibular joint (articular) disc
- ☐ Stylomandibular ligament

ATLAS REFERENCES

Netter: 111–126, 149–158
McMinn: 51–53, 62–72
Gray's Atlas: 490–502

BEFORE YOU BEGIN

The skin of the face has been previously removed (see Chapter 21).

DISSECTION STEPS

- **Continue the removal of the facial skin toward the occipital region, and separate the skin from the subcutaneous tissue (Fig. 23.1).**
- **Identify and expose the superficial temporal artery and its branches (Fig. 23.2).**
- **Once the superficial temporal artery has been fully exposed, separate the subcutaneous tissue and fat from the underlying galea aponeurotica, or *epicranial aponeurosis* (see Fig. 23.2).**
- **This aponeurosis is a flattened tendon that connects the occipitalis and frontalis muscles, forming the occipitofrontalis muscle.**
- **Cut and detach the frontalis muscle from the frontal bone.**
- **With forceps, grasp the frontalis muscle and reflect it posteriorly (Fig. 23.3).**

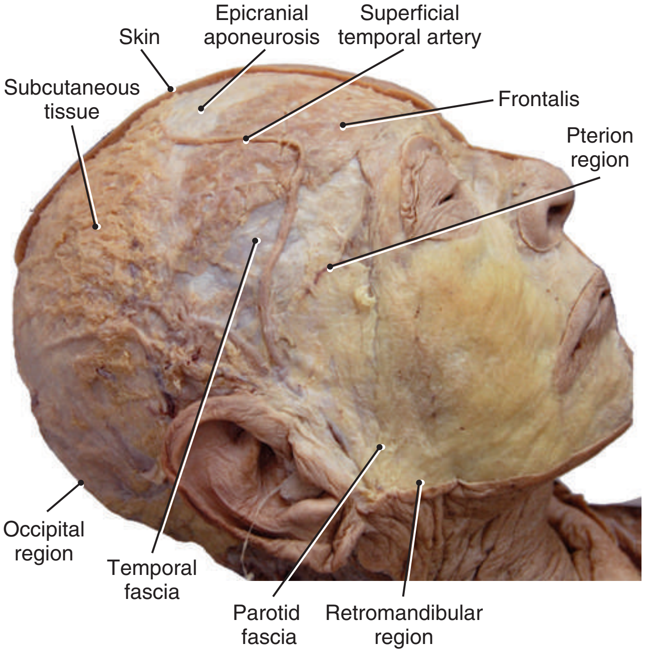

Skin
Epicranial aponeurosis
Superficial temporal artery
Subcutaneous tissue
Frontalis
Pterion region
Occipital region
Temporal fascia
Parotid fascia
Retromandibular region

Fig. 23.2 Lateral view of exposed superficial temporal artery and branches.

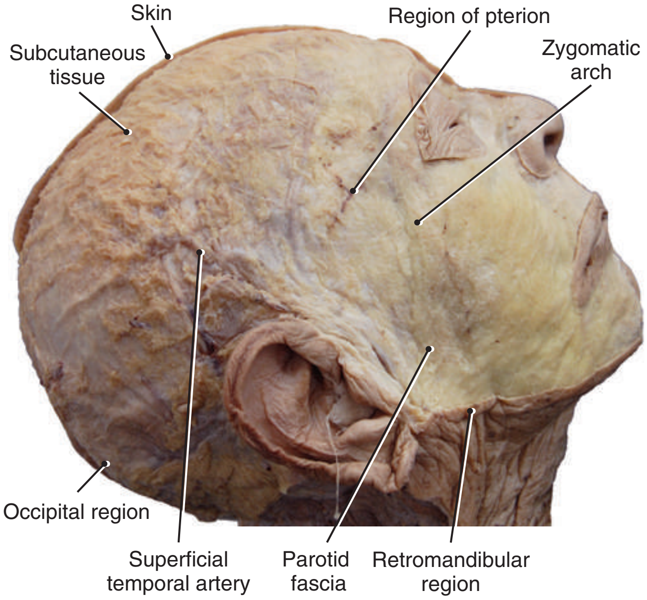

Skin
Subcutaneous tissue
Region of pterion
Zygomatic arch
Occipital region
Superficial temporal artery
Parotid fascia
Retromandibular region

Fig. 23.1 Lateral view of external cranium and face.

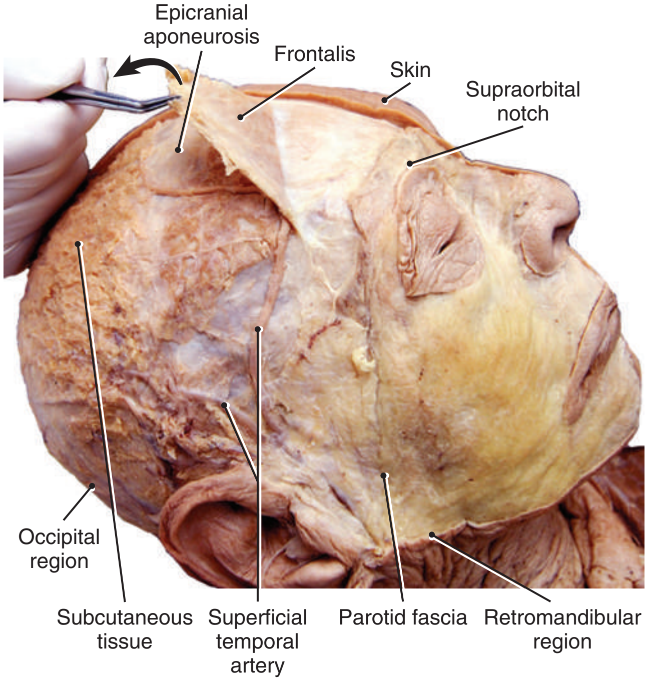

Epicranial aponeurosis
Frontalis
Skin
Supraorbital notch
Occipital region
Subcutaneous tissue
Superficial temporal artery
Parotid fascia
Retromandibular region

Fig. 23.3 Frontalis muscle detached from frontal bone and reflected posteriorly.

- On the internal surface of the frontalis muscle, note the loose areolar tissue, and on the surface of the cranium, note the *pericranium* (Fig. 23.4).
- At this part of the dissection, identify all the previously dissected layers of the *scalp* (Plate 23.1):
  - *Skin*
  - *Connective tissue (subcutaneous tissue)*
  - *Aponeurotic layer*
  - *Loose areolar tissue*
  - *Pericranium*
- To expose the brain, the *calvaria,* or "skullcap," must be removed. The calvaria consists primarily of the parietal, frontal, and occipital bones. Dissect away the occipitofrontalis muscle and expose the pericranium, leaving the temporalis fascia intact (Fig. 23.5).
- With a scalpel, reflect the temporal fascia and expose the temporalis muscle (Fig. 23.6).

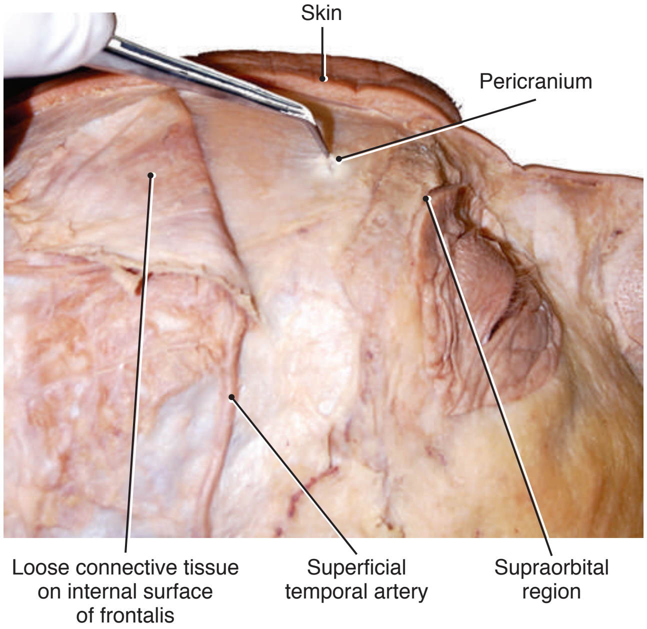

Skin
Pericranium
Loose connective tissue on internal surface of frontalis
Superficial temporal artery
Supraorbital region

Fig. 23.4 Appreciate the loose areolar tissue at the internal surface of frontalis muscle and the pericranium on cranial surface.

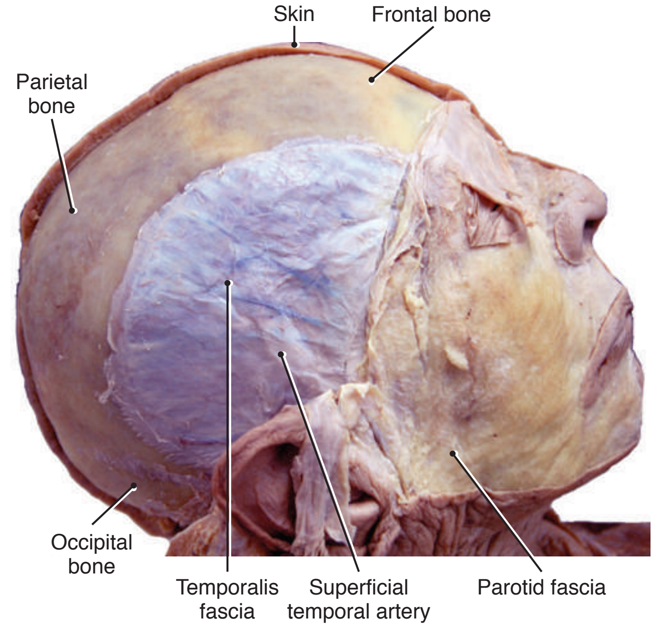

Skin
Frontal bone
Parietal bone
Occipital bone
Temporalis fascia
Superficial temporal artery
Parotid fascia

Fig. 23.5 Occipitofrontalis muscle removed, exposing pericranium and leaving temporalis fascia intact.

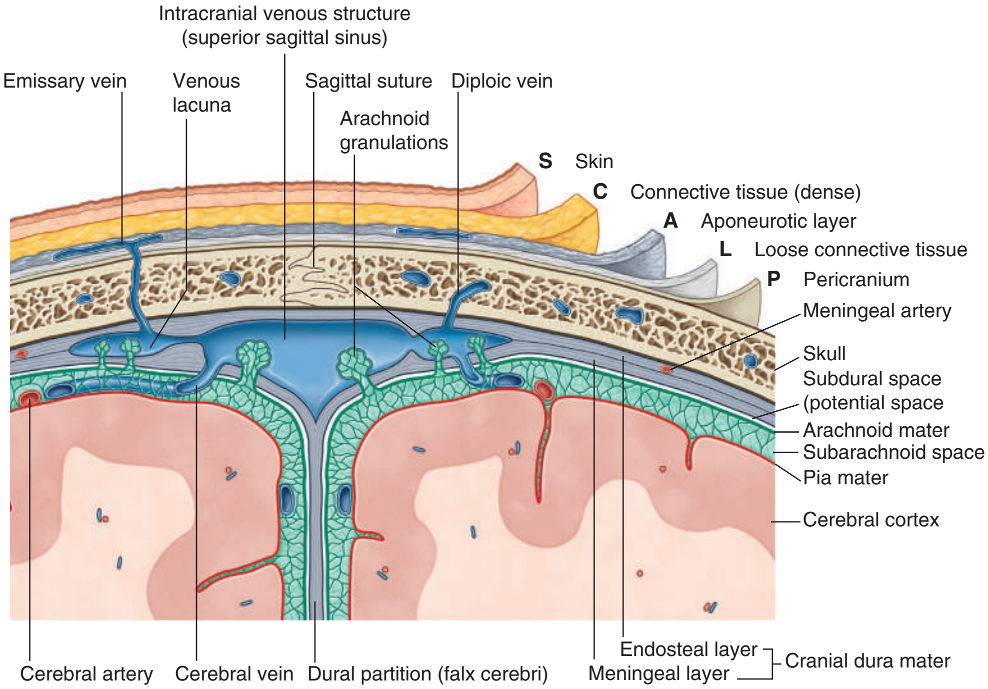

Intracranial venous structure (superior sagittal sinus)
Emissary vein
Venous lacuna
Sagittal suture
Diploic vein
Arachnoid granulations
S Skin
C Connective tissue (dense)
A Aponeurotic layer
L Loose connective tissue
P Pericranium
Meningeal artery
Skull
Subdural space (potential space
Arachnoid mater
Subarachnoid space
Pia mater
Cerebral cortex
Endosteal layer
Meningeal layer
Cranial dura mater
Cerebral artery
Cerebral vein
Dural partition (falx cerebri)

Plate 23.1 Scalp and cranial meninges.

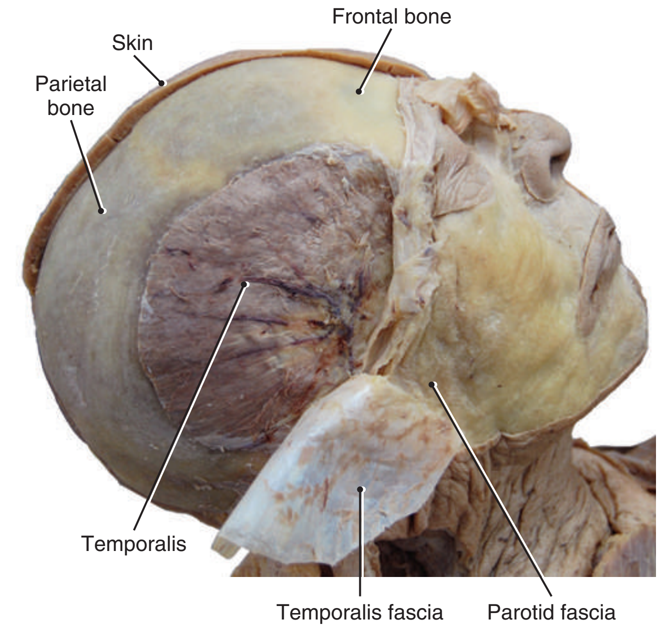

Skin
Frontal bone
Parietal bone
Temporalis
Temporalis fascia
Parotid fascia

Fig. 23.6 Temporalis fascia reflected, exposing temporalis muscle.

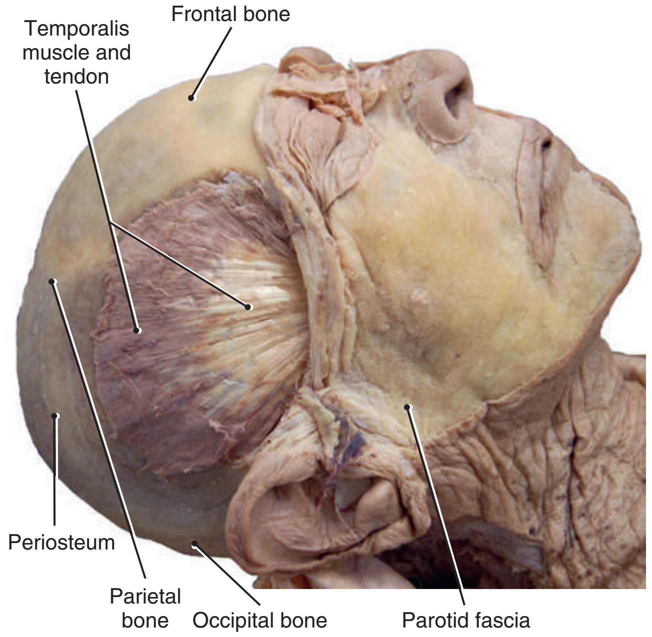

Temporalis muscle and tendon
Frontal bone
Periosteum
Parietal bone
Occipital bone
Parotid fascia

Fig. 23.7 Appreciate the temporalis muscle and tendinous fibers.

- Clean the temporalis muscle and note its tendinous fibers (Fig. 23.7).
- Reflect the temporalis toward the zygomatic bone, and expose the *pterion* (Fig. 23.8).
- Once the temporalis muscle is completely reflected and the calvaria fully exposed, identify the frontal, parietal, temporal, and occipital bones, as well as the sagittal, coronal, and lambdoid sutures.

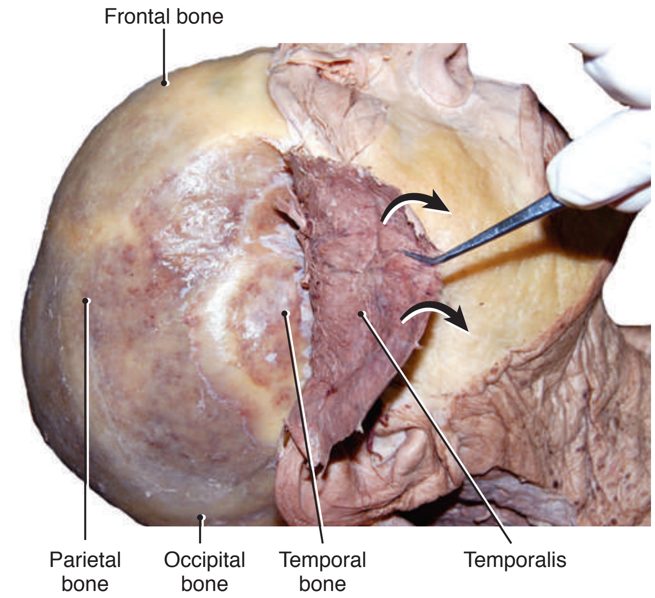

Frontal bone
Parietal bone
Occipital bone
Temporal bone
Temporalis

Fig. 23.8 Temporalis muscle reflected toward zygomatic bone, exposing pterion.

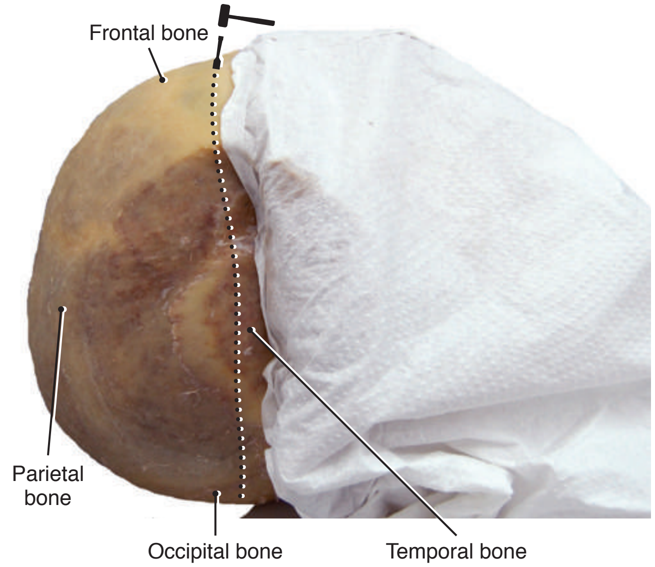

Frontal bone
Parietal bone
Occipital bone
Temporal bone

Fig. 23.9 Lateral view of external cranium and face (covered).

DISSECTION OF THE SKULL

- Keep the cadaver in the supine position.
- Place a plastic or wooden block under the head or shoulders to elevate the body from the dissection table.

DISSECTION TIP

Place paper towels around the face and temporalis muscles to protect them from bone dust (Fig. 23.9).

- We use two different techniques to expose the contents of the skull.

Technique 1

- With a marker, draw a stippled midsagittal line from the nasion to the external occipital protuberance.
- Draw a second, circumferential line passing 1 to 2 cm above the superciliary arches and ears to reach 1 to 2 cm above the external occipital protuberance posteriorly (see Fig. 23.9).
- With an electric saw, make a cut 2 to 3 cm (~1 inch) lateral to the midline, on both sides. In this way, the superior sagittal sinus and the falx cerebri will remain intact (Fig. 23.10).

DISSECTION TIP

Caution! Use the electric saw carefully.

- Make a shallow, circumferential cut of approximately 1 cm in depth.

DISSECTION TIP

Do not place the saw too deeply, because you will cut the dura and the brain. To complete the cut toward the external occipital protuberance, it is necessary to rotate the cadaver.

Once the first cut is complete, use the chisel and mallet to break through the bone and detach the two bone flaps (Fig. 23.11).

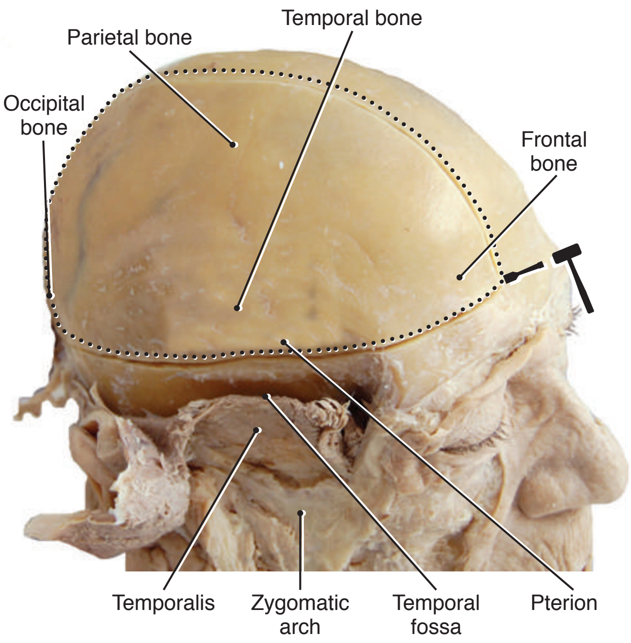

Temporal bone
Parietal bone
Occipital bone
Frontal bone
Temporalis
Zygomatic arch
Temporal fossa
Pterion

Fig. 23.10 Anterolateral view of external cranium and face.

DISSECTION TIP

Detaching the bone flap from the underlying dura mater can be challenging. Place the forceps or a chisel into the gap (created by the saw cut) between the two adjacent bones, and use it to lift it up from the dura. If the dura is attached to the calvaria, use a probe to reflect the endosteal layer away from the calvaria, leaving the dura mater intact.

- After removal of the calvaria, examine the dura mater and identify the middle meningeal artery and its branches (see Figs. 23.11 and 23.13).
- Cut and reflect the dura, and expose the subdural space (Fig. 23.12).
- Observe the arachnoid layer covering the brain and the cerebral veins penetrating the arachnoid mater (see Fig. 23.12).
- Place your hands on one of the cerebral hemispheres and retract it laterally (Fig. 23.14).
- Notice the midline connection between the two hemispheres, the corpus callosum (see Fig. 23.14).
- With a scalpel, make a midsagittal cut, and reflect one of the brain hemispheres, leaving intact the dural venous sinuses (Fig. 23.15).
- Perform the same technique to the contralateral side, and expose the sinuses bilaterally (Figs. 23.16 and 23.17).
- Identify the *falx cerebri,* a dural partition separating the right from the left cerebral hemispheres.

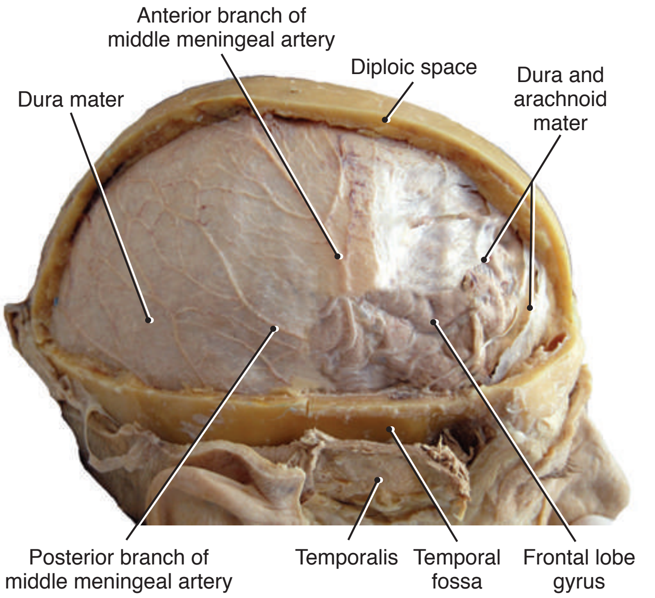
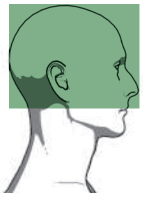

Anterior branch of middle meningeal artery
Diploic space
Dura and arachnoid mater
Dura mater
Posterior branch of middle meningeal artery
Temporalis
Temporal fossa
Frontal lobe gyrus

Fig. 23.11 Lateral view of right hemisphere after craniotomy.



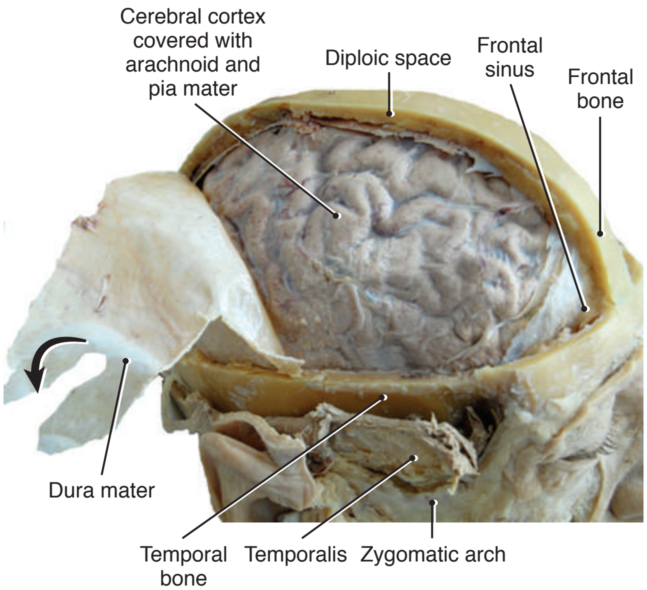
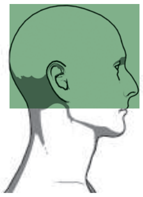

Cerebral cortex covered with arachnoid and pia mater
Diploic space
Frontal sinus
Frontal bone
Dura mater
Temporal bone
Temporalis
Zygomatic arch

Fig. 23.12 Dura mater reflected, exposing subdural space. Observe the arachnoid layer covering the brain and cerebral veins penetrating it.



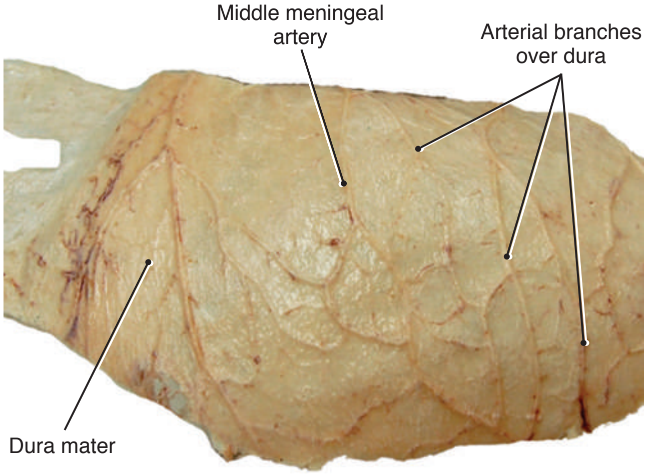

Middle meningeal artery
Arterial branches over dura
Dura mater

Fig. 23.13 External surface of removed dura mater, revealing the middle meningeal artery and arterial branches to dura mater.

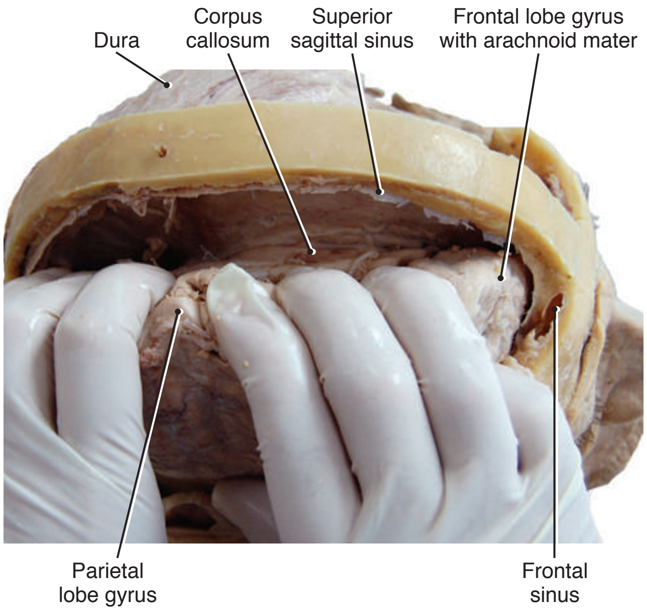
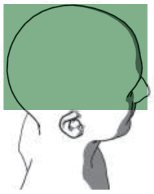

Dura
Corpus callosum
Superior sagittal sinus
Frontal lobe gyrus with arachnoid mater
Parietal lobe gyrus
Frontal sinus

Fig. 23.14 Cerebral hemisphere retracted laterally; note the frontal and superior sagittal sinuses and corpus callosum. Appreciate the connection between the two hemispheres, the corpus callosum.



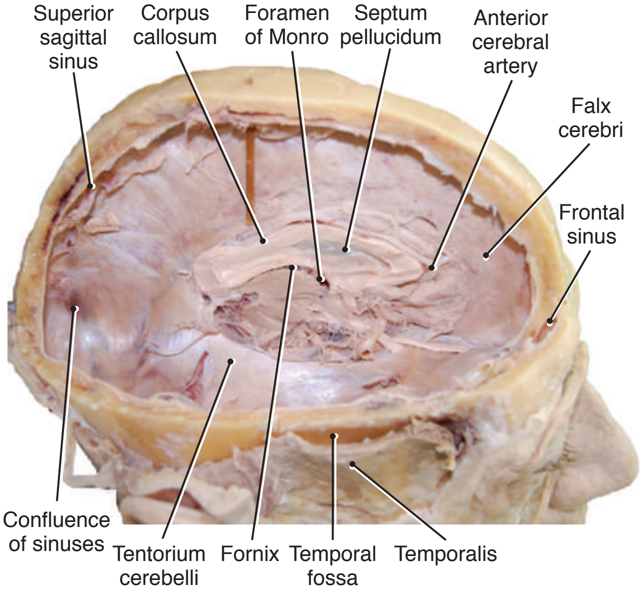
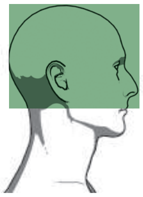

Superior sagittal sinus
Corpus callosum
Foramen of Monro
Septum pellucidum
Anterior cerebral artery
Falx cerebri
Frontal sinus
Confluence of sinuses
Tentorium cerebelli
Fornix
Temporal fossa
Temporalis

Fig. 23.15 With a midsagittal cut, the brain hemisphere is reflected, leaving the dural venous sinuses intact.



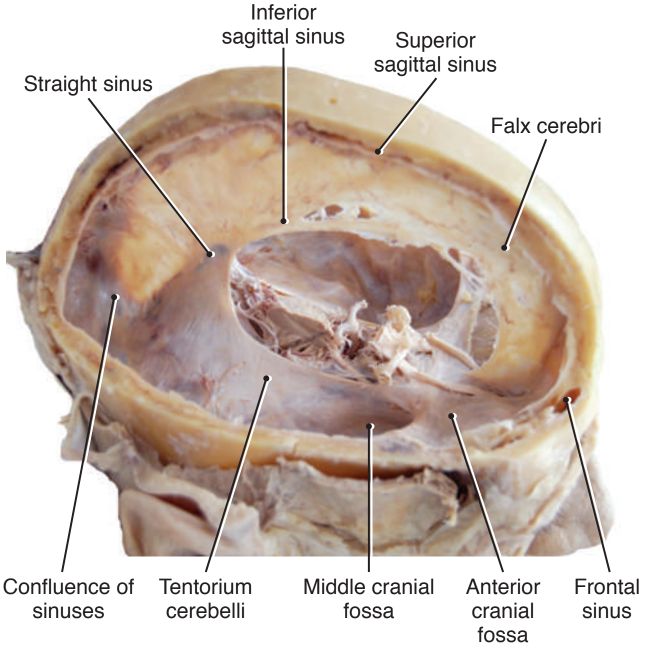
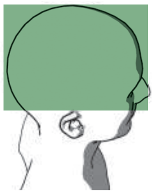

Inferior sagittal sinus
Superior sagittal sinus
Straight sinus
Falx cerebri
Confluence of sinuses
Tentorium cerebelli
Middle cranial fossa
Anterior cranial fossa
Frontal sinus

Fig. 23.16 Postcraniotomy lateral view of right hemisphere.



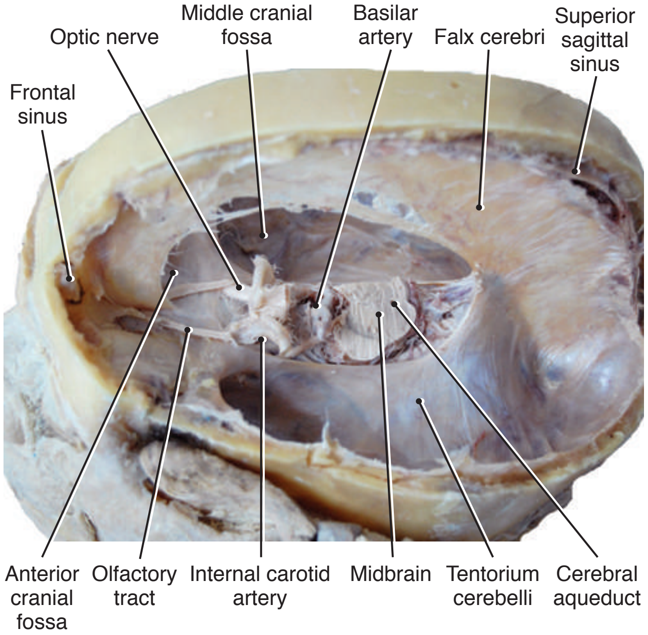
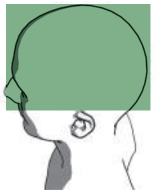

Optic nerve
Middle cranial fossa
Basilar artery
Falx cerebri
Superior sagittal sinus
Frontal sinus
Anterior cranial fossa
Olfactory tract
Internal carotid artery
Midbrain
Tentorium cerebelli
Cerebral aqueduct

Fig. 23.17 Lateral view of left hemisphere after craniotomy.



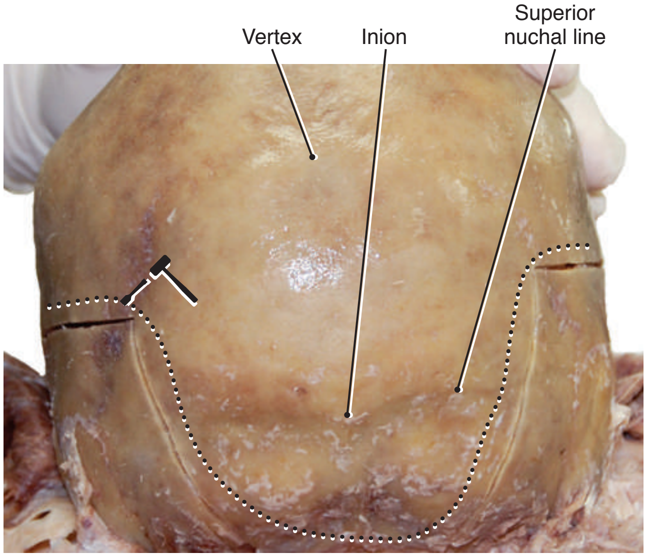

Vertex
Inion
Superior nuchal line

Fig. 23.18 Superoposterior view of external cranium revealing the superior nuchal line, inion, posterior craniotomy *(dashed line),* and vertex.

- **Superior to the falx cerebri, identify the *superior sagittal sinus,* which joins the two transverse sinuses at the confluence of sinuses ("torcular herophili," or wine-press of Herophilus).**
- **Inferolateral to the falx cerebri, look for the *tentorium cerebelli,* a large dural infolding separating the occipital lobes from the cerebellar hemispheres.**

DISSECTION **TIP**

If time permits, remove the midportion of the calvaria, and expose the superior sagittal sinus. Incise the dura forming the sinus, and notice its internal structure. In the majority of specimens the superior sagittal sinus will drain into the right transverse sinus.

- **At this point, the dissection can continue as outlined later.**

Technique 2

- **With a pen, draw a circumferential line passing 1 to 2 cm above the superciliary ridges and ears to reach 1 to 2 cm above the external occipital protuberance posteriorly (Figs. 23.18 and 23.19).**
- **With an electric saw, make a shallow, circumferential cut of about 1 cm along this line (Fig. 23.20).**

DISSECTION **TIP**

Use the electric saw carefully. To complete the cut at the external occipital protuberance, the cadaver must be rotated. Do not insert the saw too deeply, or you may sever the dura mater and the brain (Fig. 23.21).

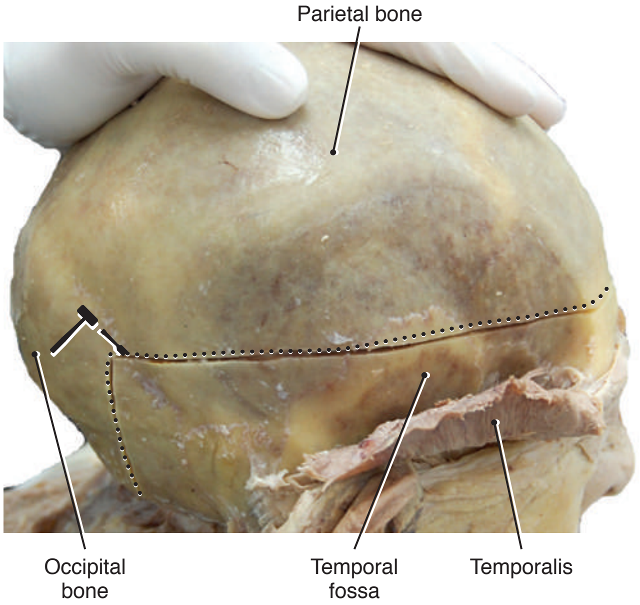
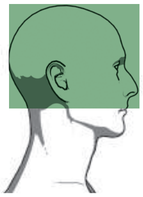

Parietal bone
Occipital bone
Temporal fossa
Temporalis

Fig. 23.19 Postcraniotomy lateral view of external cranium, revealing frontal bone, parietal bone, temporal bone/fossa, and temporalis muscle reflected inferiorly over zygomatic arch.



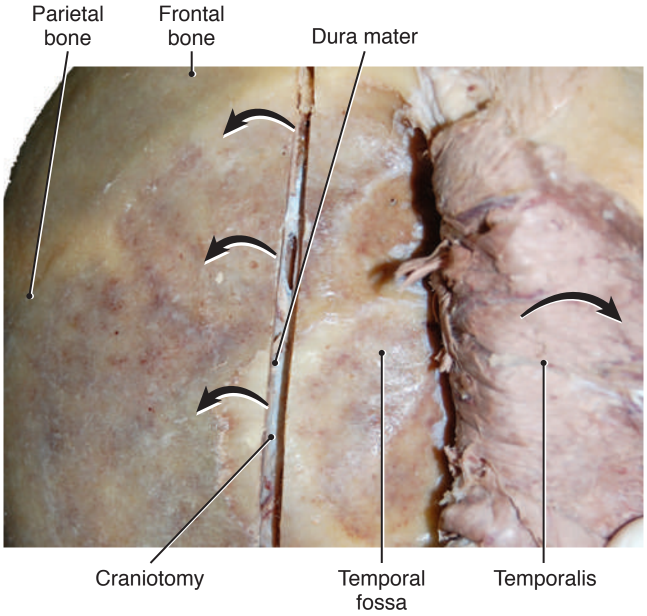

Parietal bone
Frontal bone
Dura mater
Craniotomy
Temporal fossa
Temporalis

Fig. 23.21 Once first cut is complete, use chisel and mallet to break through the bone and detach it from the dura.

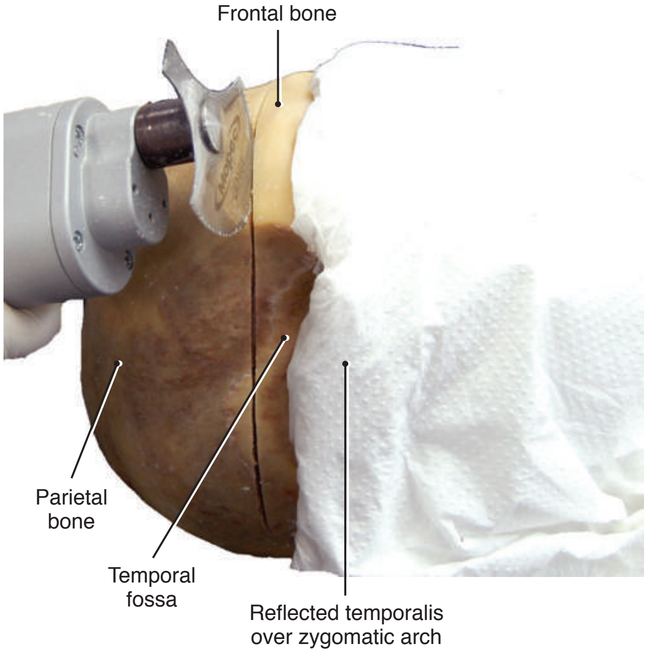

Frontal bone
Parietal bone
Temporal fossa
Reflected temporalis over zygomatic arch

Fig. 23.20 Posterolateral view of external cranium, revealing wedge resection cut.

DISSECTION **TIP**

The bone cut can extend below the external occipital protuberance, to the posterolateral aspects of the foramen magnum, including the posterior portions of the atlas and axis. With this extension, removal of the brain and spinal cord is easier. However, this extension will sever the muscles of the suboccipital triangle. If you want to preserve the suboccipital muscles, make the cut pass through the external occipital protuberance instead (Fig. 23.22).

- **Second, complete the bone removal with a chisel and mallet to break through the bone, and detach it from the underlying dura mater (Fig. 23.23).**

DISSECTION **TIP**

Detaching the bone from the underlying dura can be challenging. Place the chisel in the gap (created by saw cut) between the adjacent bones, slightly rotating it to lift the bone from the dura. If the dura is still connected to the calvaria, use a probe to reflect the endosteal layer from the calvaria, leaving the dura intact.

- **Inspect the internal surface of the calvaria and identify the small openings for emissary veins.**
- **Note the small pits (granular *fovea*) produced by the *arachnoid granulations* (large arachnoid *villi* that protrude into dural venous sinuses) (Fig. 23.24).**
- **Look for the frontal sinus extending into the calvaria.**

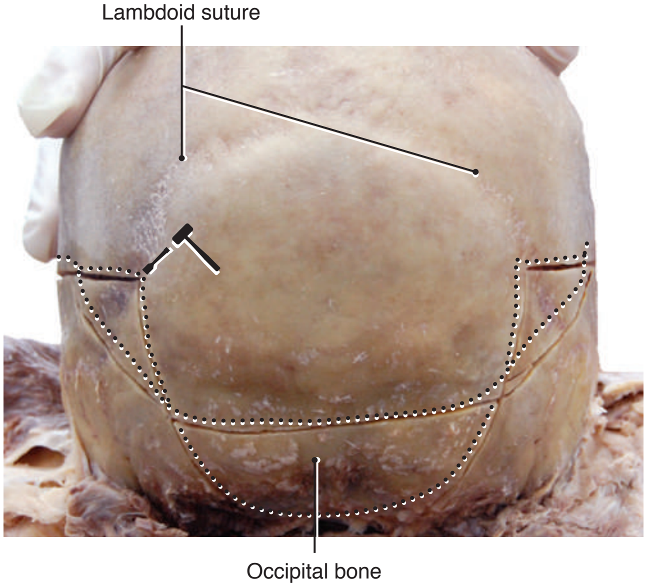

Lambdoid suture
Occipital bone

Fig. 23.22 Posterior view of external cranium shows of the cranium *(dashed line),* lambdoid suture, and occipital bone, preserving the muscles of the suboccipital triangle.

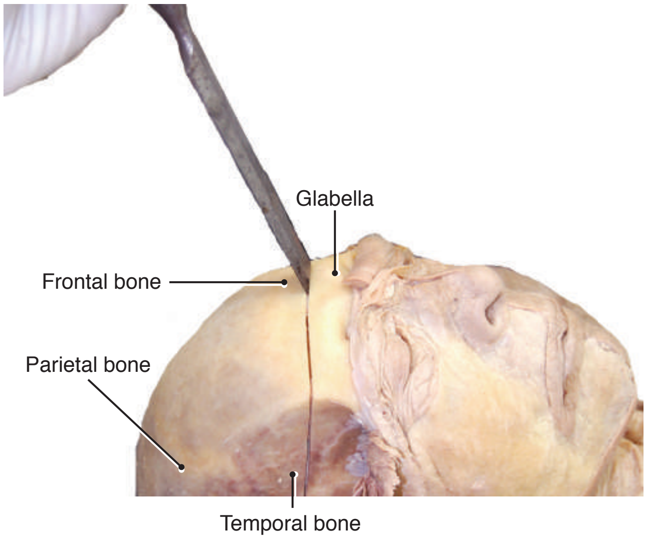

Glabella
Frontal bone
Parietal bone
Temporal bone

Fig. 23.23 Anterolateral view of external cranium and face revealing sagittal suture line for craniotomy, with chisel inserted into scoring line and glabella.

- Note the spongy bone occupying the space between the outer and inner compact bony layers (tables), the *diploic space.*
- Identify the impressions made by the superior sagittal sinus and the middle meningeal arteries.
- Inspect the dura mater and identify the middle meningeal artery and its branches (Fig. 23.25).
- Identify the superior sagittal sinus and look for the *lateral lacunae* (Fig. 23.26). The lateral lacunae are lateral venous extensions of the superior sagittal sinus.

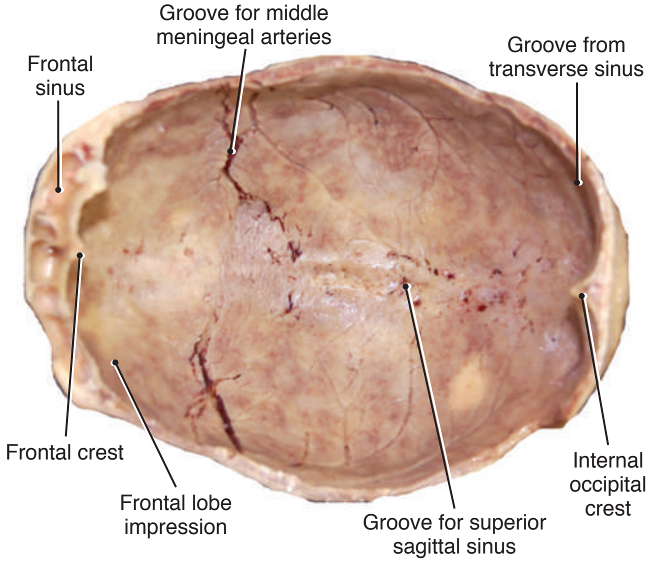
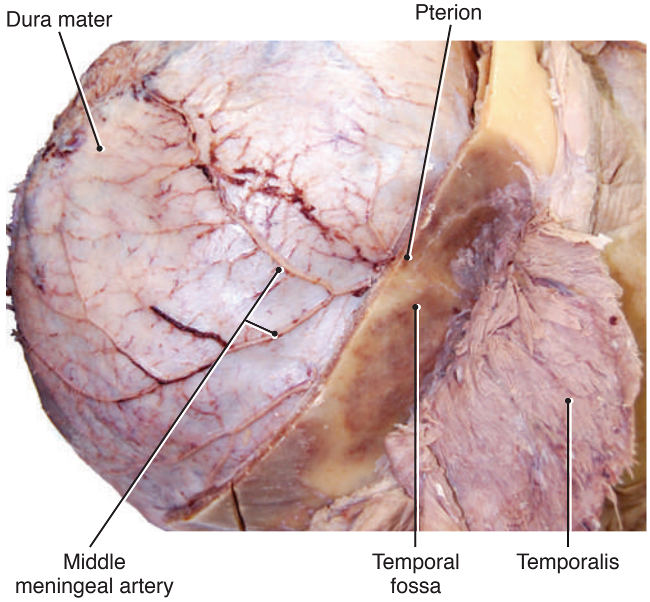

Groove for middle meningeal arteries
Frontal sinus
Groove from transverse sinus
Frontal crest
Internal occipital crest
Frontal lobe impression
Groove for superior sagittal sinus

Fig. 23.24 Craniotomy with calvaria removed, revealing internal surface.


Dura mater
Pterion
Middle meningeal artery
Temporal fossa
Temporalis

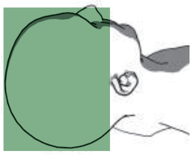


Fig. 23.25 Lateral view showing dura mater, middle meningeal artery branches, pterion, temporal fossa, and temporalis muscle.

DISSECTION **TIP**

If time permits, with a scalpel make an incision into the lateral lacunae, and note their opening to the superior sagittal sinus.

- Cut the dura 2 to 3 cm (~1 inch) lateral to the midline, and reflect it inferiorly (Figs. 23.27 and 23.28).
- Inspect the subdural space and the arachnoid layer pierced with cerebral veins.
- Identify the arachnoid mater, and make a small incision to expose the pia mater.

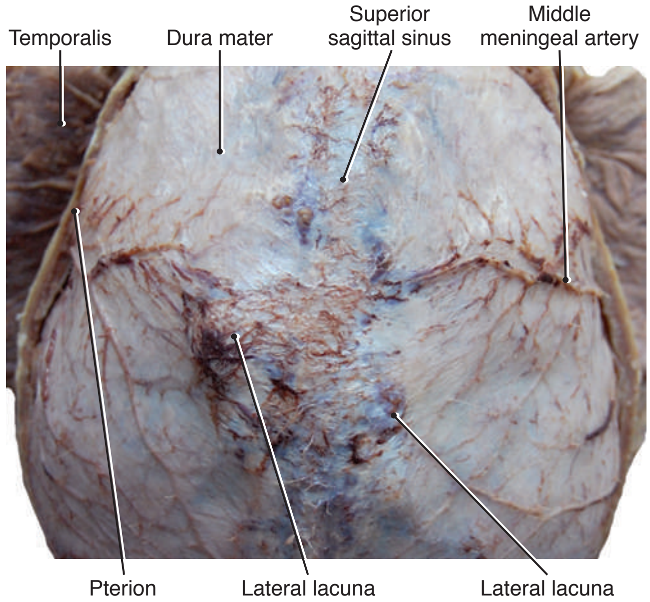
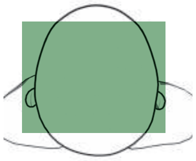

Temporalis
Dura mater
Superior sagittal sinus
Middle meningeal artery
Pterion
Lateral lacuna
Lateral lacuna

Fig. 23.26 Superior view of craniotomy, revealing superior sagittal sinus, middle meningeal artery, lateral lacuna, dura mater, temporalis muscle, and pterion.



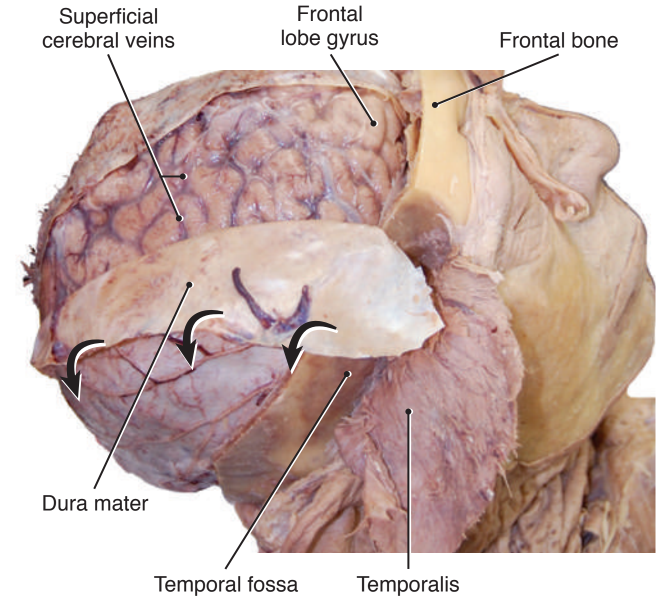

Superficial cerebral veins
Frontal lobe gyrus
Frontal bone
Dura mater
Temporal fossa
Temporalis

Fig. 23.28 Anterolateral view of craniotomy revealing reflected dura mater, temporal bone region, temporalis muscle, frontal bone region, frontal lobe gyri covered with arachnoid and pia mater, and superior cerebral veins of parietal lobe.

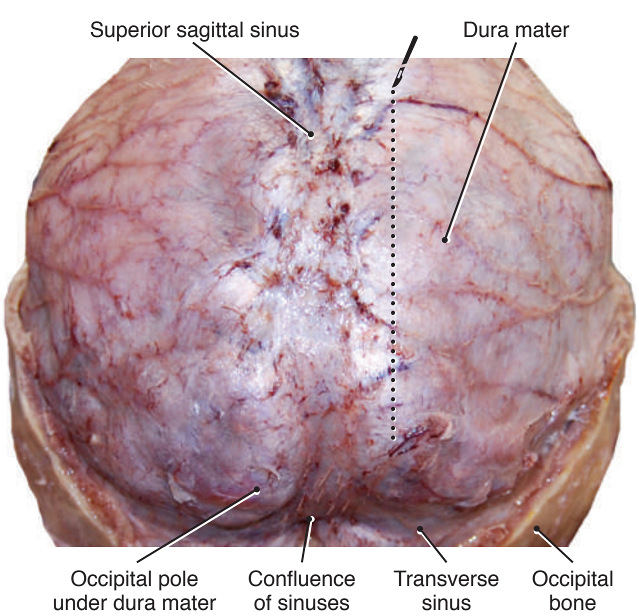

Superior sagittal sinus
Dura mater
Occipital pole under dura mater
Confluence of sinuses
Transverse sinus
Occipital bone

Fig. 23.27 Dura mater cut laterally from midline *(dashed line)* and reflected inferiorly.

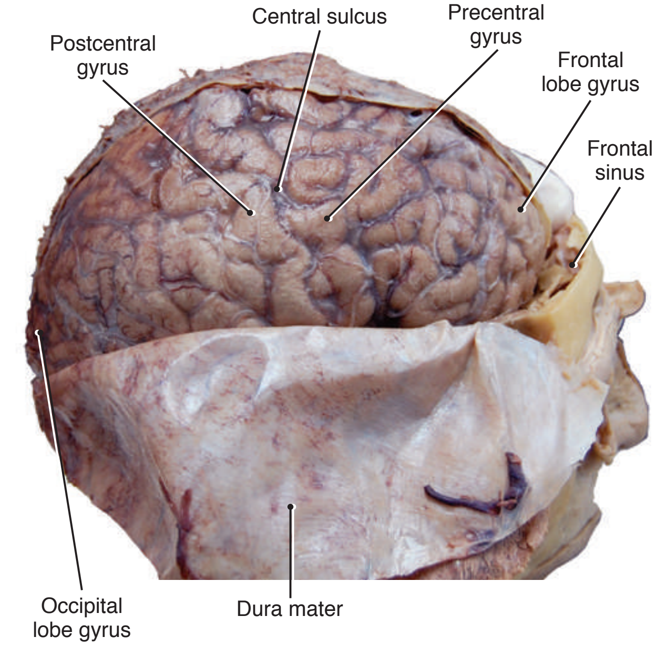
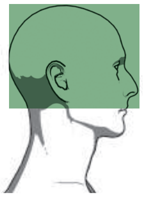

Central sulcus
Precentral gyrus
Postcentral gyrus
Frontal lobe gyrus
Frontal sinus
Occipital lobe gyrus
Dura mater

Fig. 23.29 Lateral view of craniotomy with dura mater reflected laterally, revealing key gyri, central sulcus, and frontal sinus.



- ○ Notice how the cerebral arteries and veins are covered with pia mater.
- ○ On the brain, identify the central sulcus, precentral gyrus, postcentral gyrus, and the frontal and occipital lobes (Fig. 23.29).
- ○ On the other side of the brain, remove the pia mater (Fig. 23.30).
- ○ With forceps, pull the superior sagittal sinus and the falx cerebri laterally, and observe the corpus callosum (Fig. 23.31).

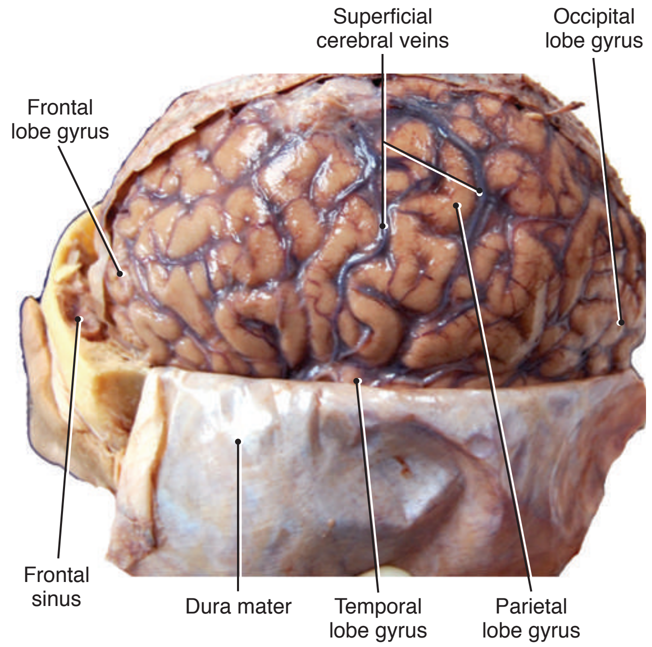
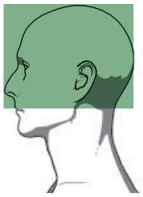

Superficial cerebral veins
Occipital lobe gyrus
Frontal lobe gyrus
Frontal sinus
Dura mater
Temporal lobe gyrus
Parietal lobe gyrus

Fig. 23.30 Pia mater removed from the brain.



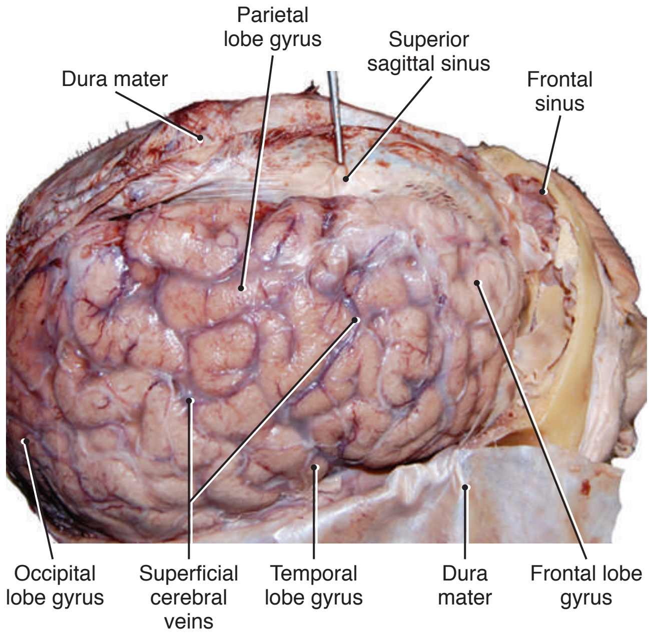
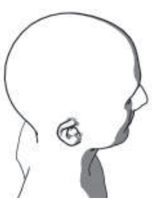

Parietal lobe gyrus
Superior sagittal sinus
Dura mater
Frontal sinus
Occipital lobe gyrus
Superficial cerebral veins
Temporal lobe gyrus
Dura mater
Frontal lobe gyrus

Fig. 23.31 Superior sagittal sinus and falx cerebri pulled laterally, revealing corpus callosum.



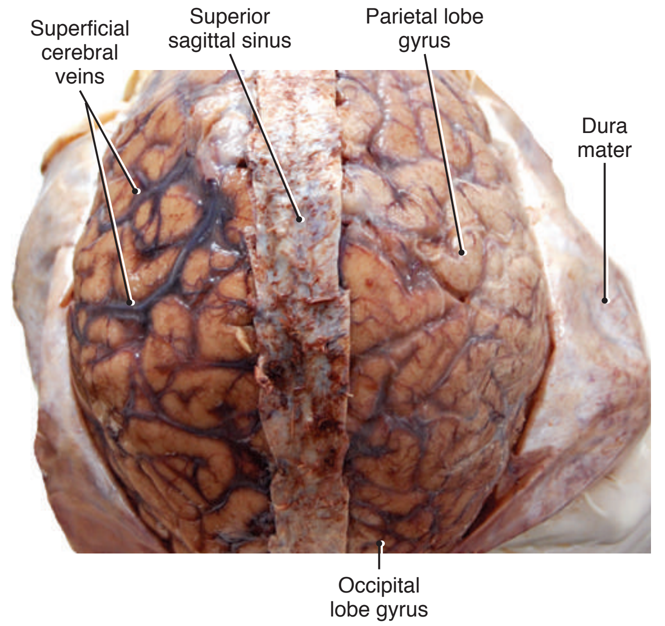
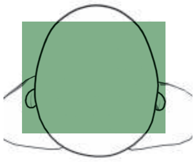

Superficial cerebral veins
Superior sagittal sinus
Parietal lobe gyrus
Dura mater
Occipital lobe gyrus

Fig. 23.32 Appreciate the superior sagittal sinus, lacunae, and tuft-like arachnoid granulations.



- Observe the superior sagittal sinus, and identify the lacunae joining it.
- Look for the tuft-like projections, the arachnoid granulations (Fig. 23.32).

ANATOMY **NOTE**

Appreciate the relationships of the following:

- The *falx cerebri* separates the two cerebral hemispheres.
- The *falx cerebelli* separates the two cerebellar hemispheres.
- The *tentorium cerebelli* separates the cerebellum from the occipital lobes.

- Gently lift the cerebral hemispheres.
- Inferior to the frontal lobes identify the attachment of the falx cerebri at the *crista galli*.
- Cut this attachment from the crista galli and from the cerebral veins draining into the superior sagittal sinus.
- Pull the detached falx cerebri and superior sagittal sinus posteriorly (Fig. 23.33).
- Gently lift the cerebral hemispheres by placing your fingertips underneath the frontal lobes of the brain (Fig. 23.34).
- Look at the space between the cribriform plate of the ethmoid bone and the frontal lobes for the internal carotid artery, olfactory tracts, olfactory bulbs, optic nerve, optic chiasm, and anterior cerebral artery (Fig. 23.35).

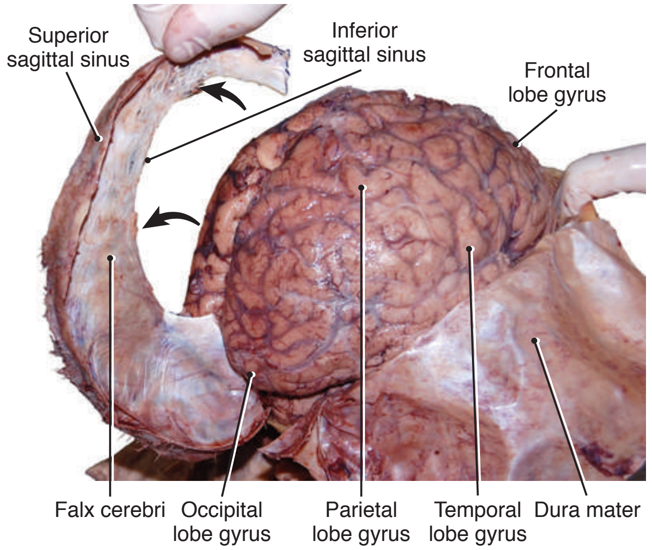
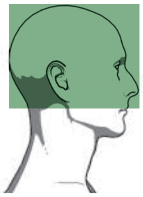

Superior sagittal sinus
Inferior sagittal sinus
Frontal lobe gyrus
Falx cerebri
Occipital lobe gyrus
Parietal lobe gyrus
Temporal lobe gyrus
Dura mater

Fig. 23.33 Anterolateral view with dura mater reflected laterally.



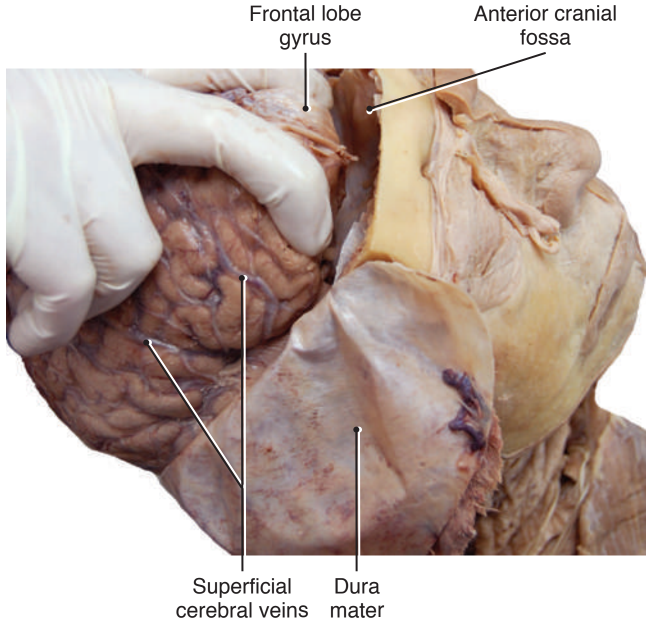

Frontal lobe gyrus
Anterior cranial fossa
Superficial cerebral veins
Dura mater

Fig. 23.34 Gently lift cerebral hemispheres by placing fingertips underneath frontal lobes.

- With scissors, cut the aforementioned structures (Fig. 23.36).
- Gently keep lifting the frontal lobes upward, and expose the brainstem and the basilar artery (Figs. 23.37 and 23.38).
- At this point, lift the occipital lobes of the cerebral hemisphere, and appreciate the tentorium cerebelli and the straight sinus (Fig. 23.39).
- With a scalpel, carefully make a circumferential cut along the lateral attachment of the tentorium cerebelli.

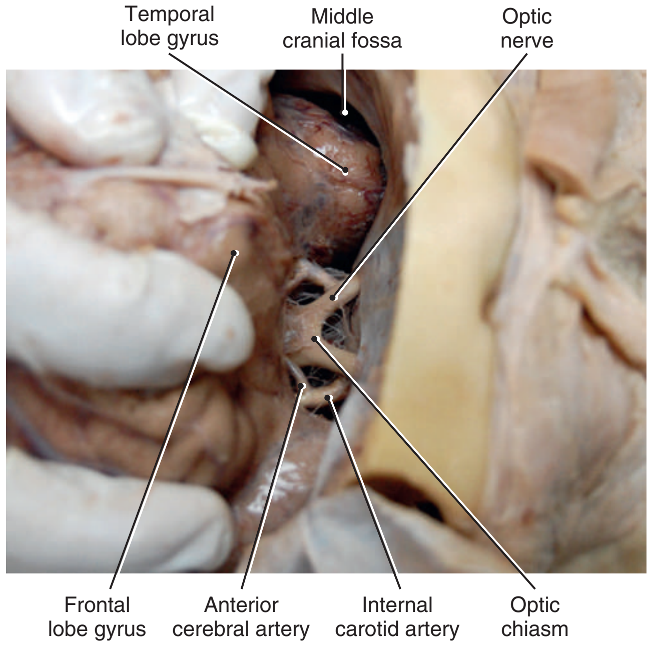

Temporal lobe gyrus
Middle cranial fossa
Optic nerve
Frontal lobe gyrus
Anterior cerebral artery
Internal carotid artery
Optic chiasm

Fig. 23.35 In space between cribriform plate of ethmoid bone and frontal lobes, appreciate the internal carotid artery, olfactory tracts/bulbs, optic nerve/chiasm, and anterior cerebral artery.

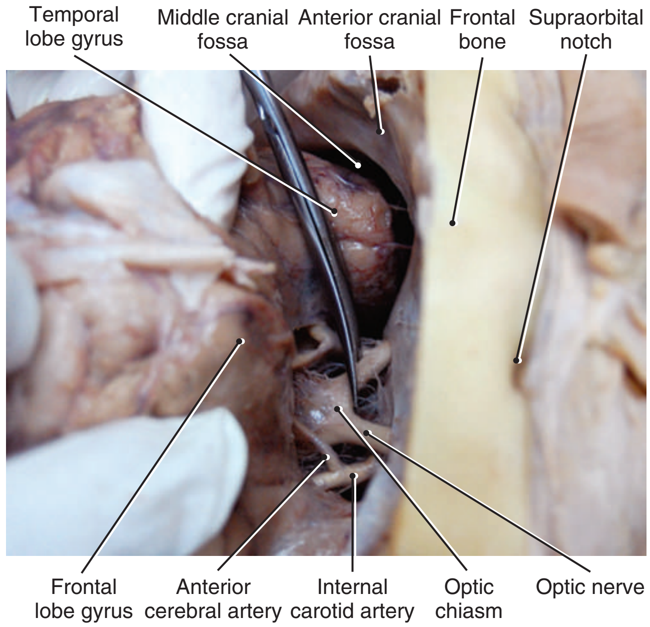
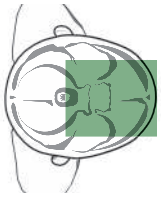

Temporal lobe gyrus
Middle cranial fossa
Anterior cranial fossa
Frontal bone
Supraorbital notch
Frontal lobe gyrus
Anterior cerebral artery
Internal carotid artery
Optic chiasm
Optic nerve

Fig. 23.36 Insert a pair of scissors and cut the optic nerve and internal carotid artery.



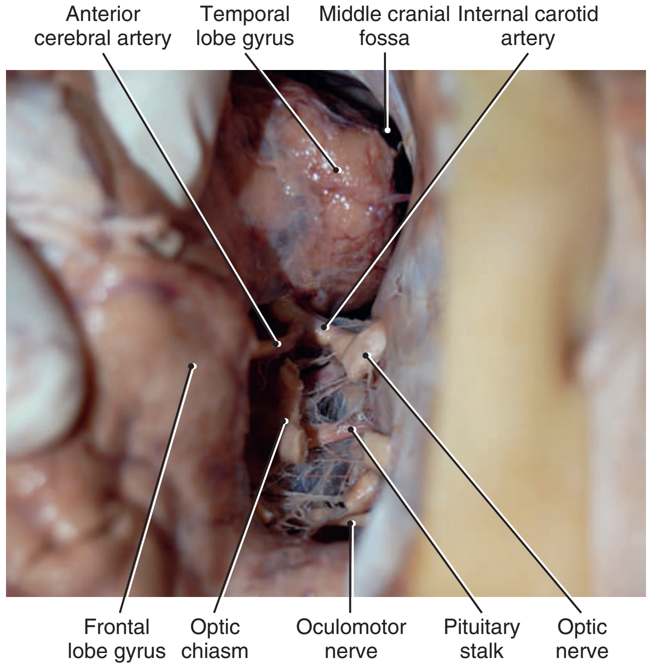
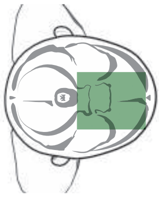

Anterior cerebral artery
Temporal lobe gyrus
Middle cranial fossa
Internal carotid artery
Frontal lobe gyrus
Optic chiasm
Oculomotor nerve
Pituitary stalk
Optic nerve

Fig. 23.37 View with frontal lobes reflected superoposteriorly revealing temporal lobe, middle cranial fossa, cut optic nerves, internal carotid artery, anterior cerebral artery, optic chiasm cut, oculomotor nerve, and pituitary stalk.



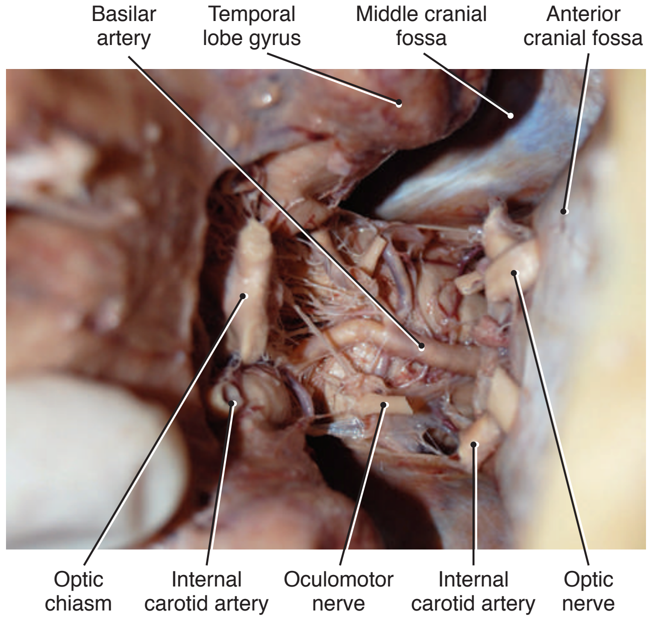
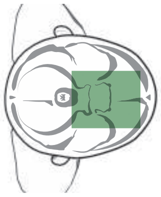

Basilar artery
Temporal lobe gyrus
Middle cranial fossa
Anterior cranial fossa
Optic chiasm
Internal carotid artery
Oculomotor nerve
Internal carotid artery
Optic nerve

Fig. 23.38 Anterosuperior view of craniotomy with frontal lobes reflected superiorly and posteriorly, revealing anterior/middle cranial fossae, temporal lobe, optic nerve cut, internal carotid artery cut, basilar artery, optic chiasm cut, and oculomotor nerve.



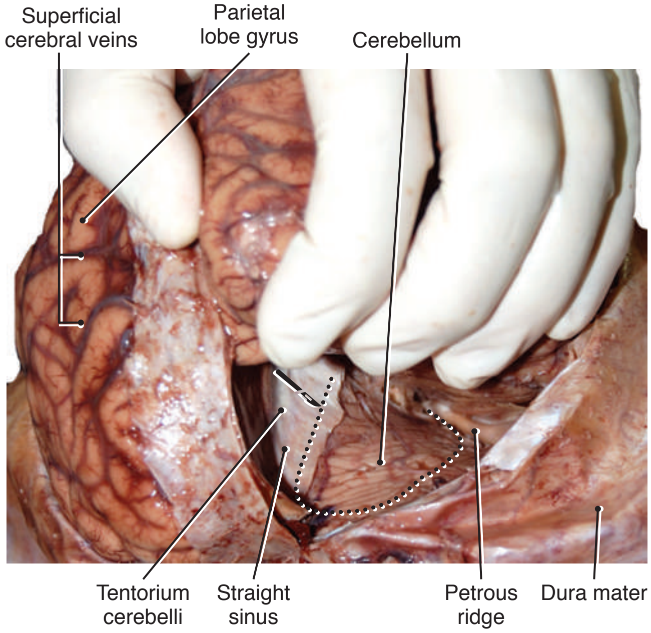

Superficial cerebral veins
Parietal lobe gyrus
Cerebellum
Tentorium cerebelli
Straight sinus
Petrous ridge
Dura mater

Fig. 23.39 Occipital lobes lifted to visualize tentorium cerebelli and straight sinus; circumferential cut from lateral attachment of tentorium cerebelli alongside transverse sinus toward petrous ridge to tentorial notch.

- Return to the frontal lobes and pull them upward (Fig. 23.40).
- Cut the facial, vestibulocochlear, trigeminal, abducens, and trochlear nerves.
- Because the tentorium cerebelli has been cut, pull the brain farther back and note the vertebral arteries forming the basilar artery (Fig. 23.41).

DISSECTION **TIP**

The point at which you need to stop pulling the brain backward is when you visualize the junction where the vertebral arteries form the basilar artery.

- Once you observe the vertebral arteries, cut the hypoglossal, accessory, glossopharyngeal, and vagus nerves.
- At this point, place a scalpel as deeply as possible within the foramen magnum, and cut the spinal cord (Fig. 23.42).
- Retract the brain from the base of the skull, leaving intact the dural venous sinuses (Fig. 23.43).
- Once the brain is removed, identify the different dural venous sinuses, the superior sagittal sinus, inferior sagittal sinus, confluence of the sinuses, straight sinus, transverse sinus, sigmoid sinus, and the great vein of Galen (see Fig. 23.18).

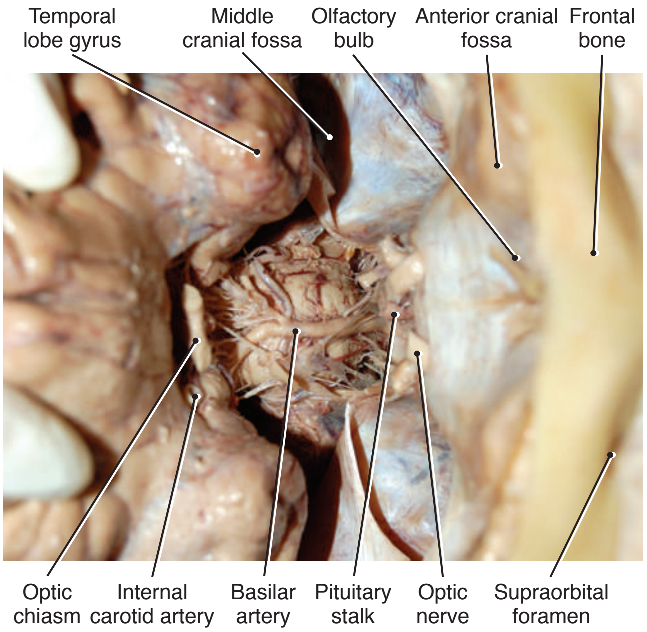

Temporal lobe gyrus
Middle cranial fossa
Olfactory bulb
Anterior cranial fossa
Frontal bone
Optic chiasm
Internal carotid artery
Basilar artery
Pituitary stalk
Optic nerve
Supraorbital foramen

Fig. 23.40 Anterosuperior view of craniotomy with frontal lobes reflected superiorly and posteriorly revealing frontal bone, supraorbital foramen, anterior cranial fossa, olfactory tract cut, optic nerve cut, middle cranial fossa, temporal lobe, internal carotid artery cut, optic nerves cut, pituitary stalk cut, and basilar artery.

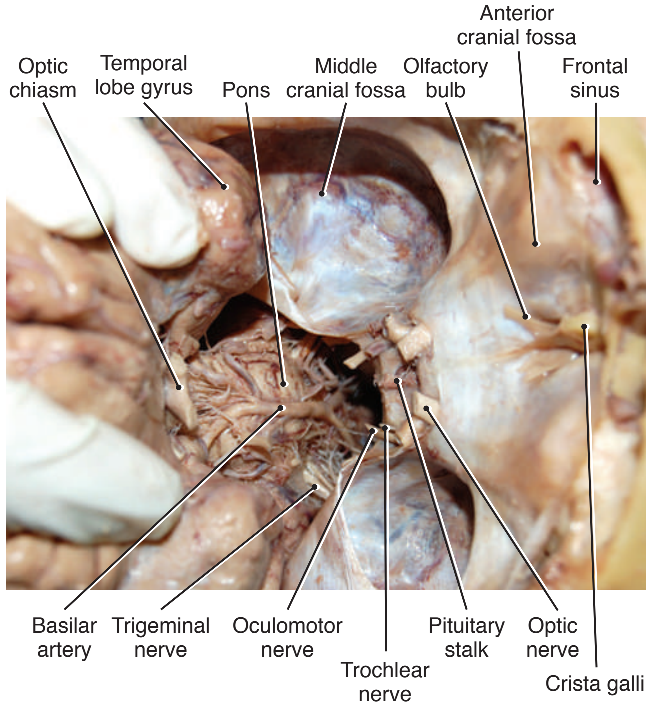

Anterior cranial fossa
Optic chiasm
Temporal lobe gyrus
Pons
Middle cranial fossa
Olfactory bulb
Frontal sinus
Basilar artery
Trigeminal nerve
Oculomotor nerve
Trochlear nerve
Pituitary stalk
Optic nerve
Crista galli

Fig. 23.41 Appreciate the facial, vestibulocochlear, trigeminal, abducens, and trochlear nerves; brain pulled farther back to visualize vertebral arteries forming basilar artery.

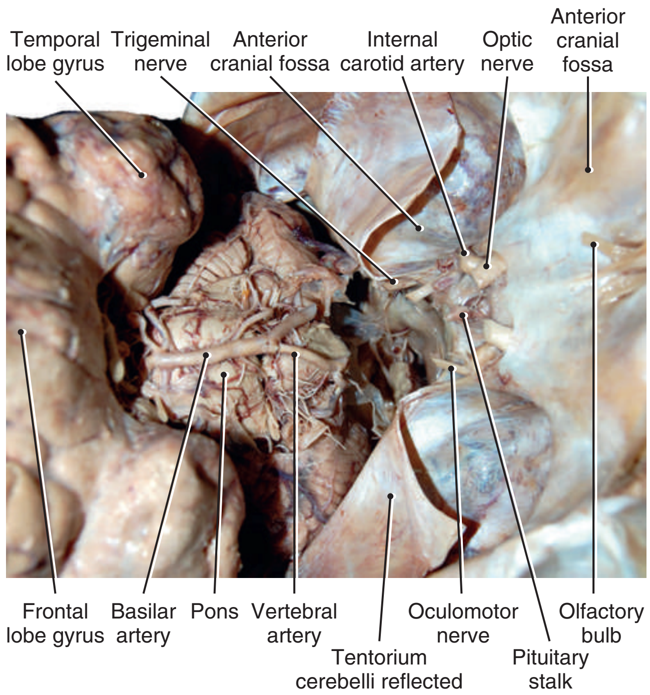

Temporal lobe gyrus
Trigeminal nerve
Anterior cranial fossa
Internal carotid artery
Optic nerve
Anterior cranial fossa
Frontal lobe gyrus
Basilar artery
Pons
Vertebral artery
Tentorium cerebelli reflected
Oculomotor nerve
Pituitary stalk
Olfactory bulb

Fig. 23.42 With tentorium cerebelli reflected, appreciate hypoglossal, accessory, glossopharyngeal, and vagus nerves.

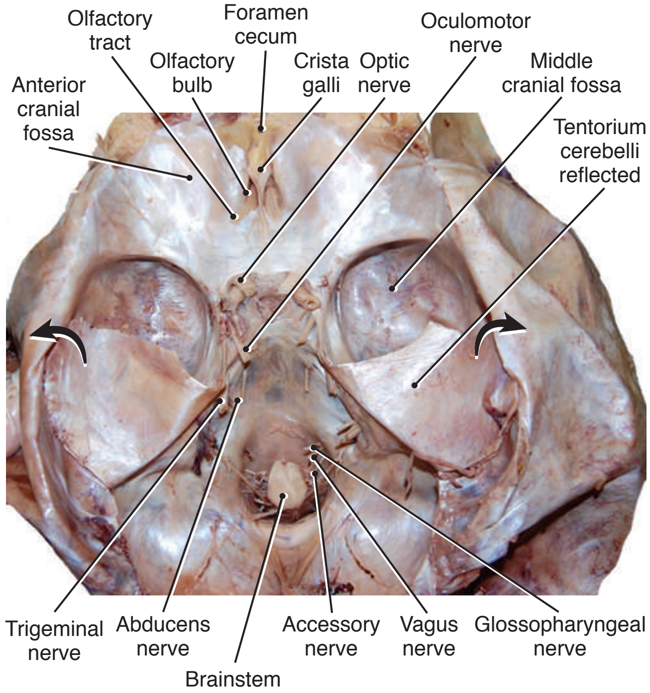

Olfactory tract
Foramen cecum
Oculomotor nerve
Anterior cranial fossa
Olfactory bulb
Crista galli
Optic nerve
Middle cranial fossa
Tentorium cerebelli reflected
Trigeminal nerve
Abducens nerve
Brainstem
Accessory nerve
Vagus nerve
Glossopharyngeal nerve

Fig. 23.43 Brain retracted from base of skull, leaving dural venous sinuses intact.

EXAMINATION OF THE BRAIN

- Once the brain is removed, dissect away the arachnoid and pia mater from its ventral surface.
- Identify the cranial nerves on the brain (Figs. 23.44 and 23.45, Plate 23.2), as follows:
  - **Cranial nerve I:** The *olfactory bulbs and tracts* usually are found in contact with the frontal lobes of the brain.
  - **Cranial nerve II:** The *optic nerves* and the *optic chiasm* are usually well preserved in most cadavers. Posterior to the optic chiasm, identify the pituitary stalk.
  - **Cranial nerve III:** The *oculomotor nerve* passes between the posterior cerebral and superior cerebellar arteries, near the termination of the basilar artery.
  - **Cranial nerve IV:** The *trochlear nerve* is the smallest cranial nerve (less the olfactory nerves) and often is cut during brain removal. It passes anteriorly around the sides of the midbrain.
  - **Cranial nerve V:** The *trigeminal nerve* arises from the middle of the lateral aspect of the pons.
  - **Cranial nerve VI:** The *abducens nerve* arises from the inferior border of the pons, immediately superior to the medullary pyramids.
  - **Cranial nerve VII:** The *facial nerve* arises on the lateral aspect of the junction of the pons and the medulla oblongata, medial to the origin of cranial nerve VIII.

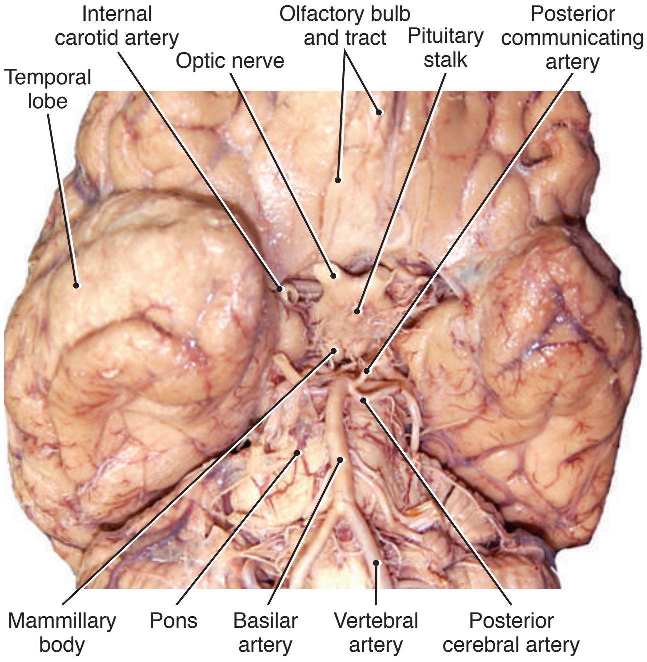

Internal carotid artery
Olfactory bulb and tract
Posterior communicating artery
Optic nerve
Pituitary stalk
Temporal lobe
Mammillary body
Pons
Basilar artery
Vertebral artery
Posterior cerebral artery

Fig. 23.44 Inferior aspect of brain, revealing olfactory bulb and tract, optic nerve, pituitary stalk, temporal lobe, mammillary bodies, and arteries (internal carotid, posterior communicating, basilar, vertebral, posterior cerebral).

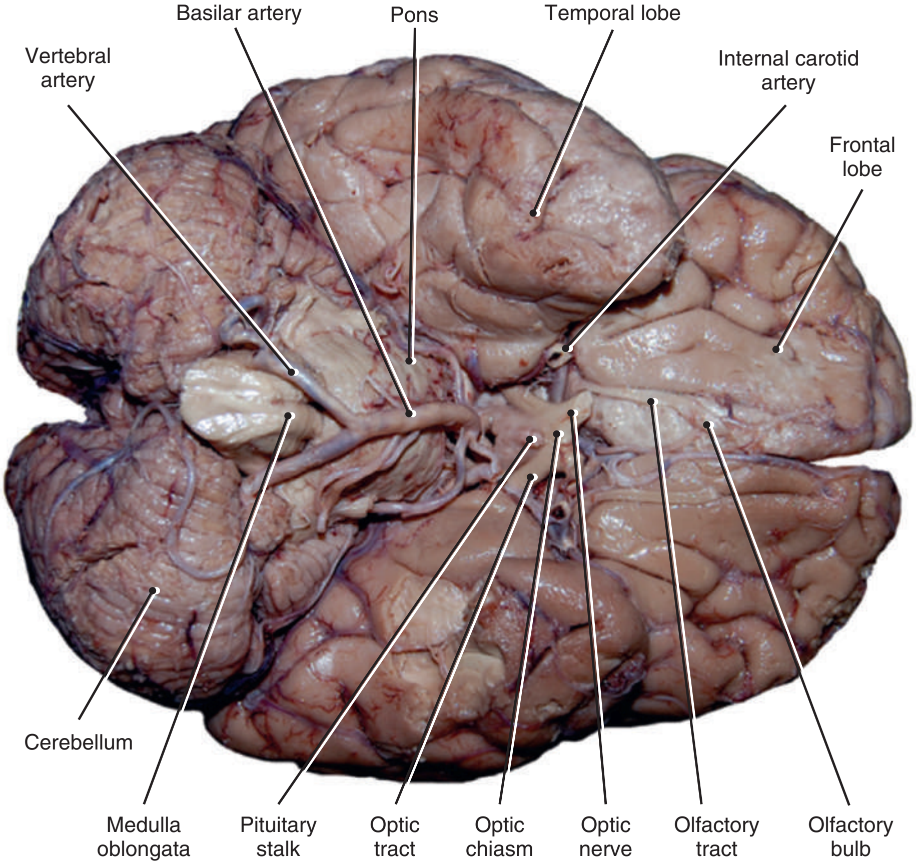

Basilar artery
Pons
Temporal lobe
Vertebral artery
Internal carotid artery
Frontal lobe
Cerebellum
Medulla oblongata
Pituitary stalk
Optic tract
Optic chiasm
Optic nerve
Olfactory tract
Olfactory bulb

Fig. 23.45 Inferior aspect of brain, revealing olfactory bulb and tract, frontal lobe, optic chiasm, optic nerve, optic tract, internal carotid artery, pituitary stalk, temporal lobe, pons, medulla oblongata, basilar artery, vertebral artery, and cerebellum.

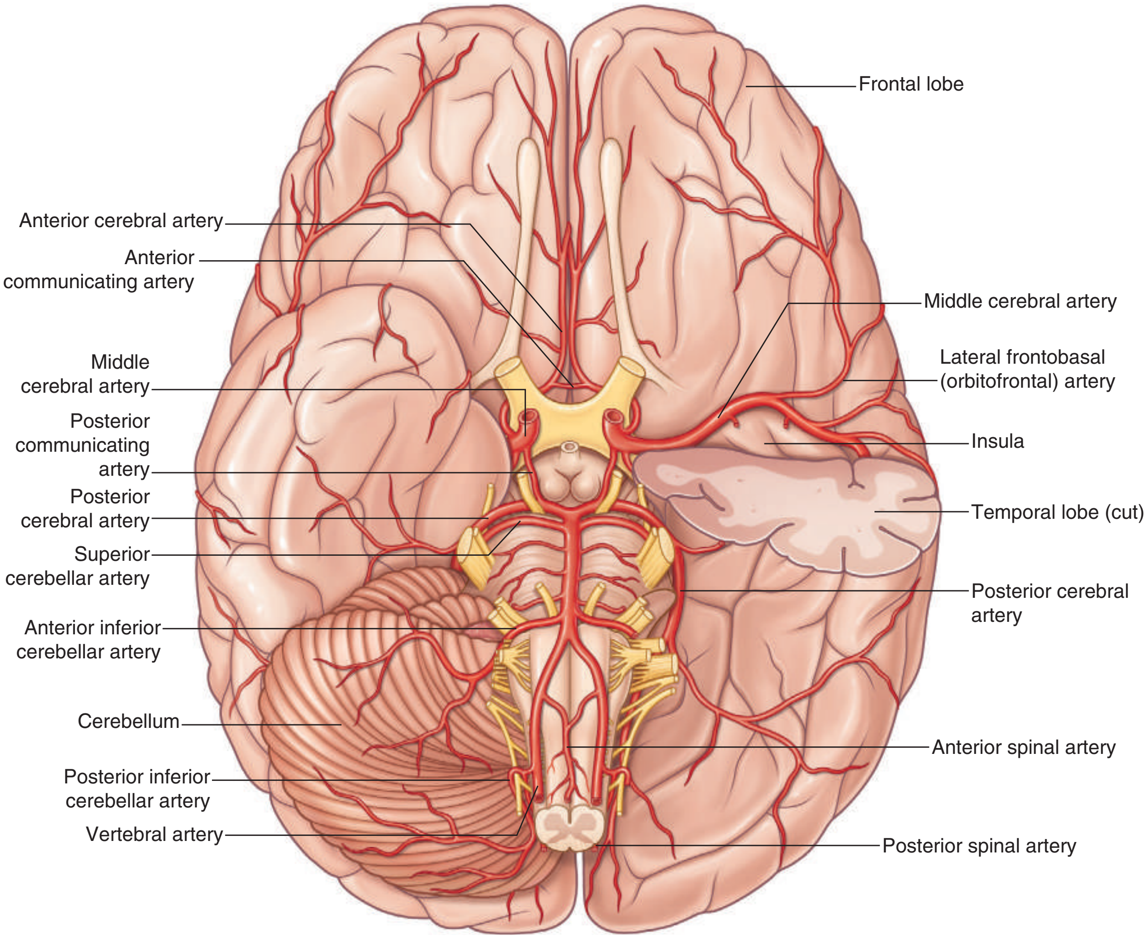

Frontal lobe
Anterior cerebral artery
Anterior communicating artery
Middle cerebral artery
Middle cerebral artery
Lateral frontobasal (orbitofrontal) artery
Posterior communicating artery
Insula
Posterior cerebral artery
Temporal lobe (cut)
Superior cerebellar artery
Posterior cerebral artery
Anterior inferior cerebellar artery
Cerebellum
Anterior spinal artery
Posterior inferior cerebellar artery
Vertebral artery
Posterior spinal artery

Plate 23.2 Arterial supply of the brain and cranial nerves.

- **Cranial nerve VIII:** The *vestibulocochlear nerve* arises lateral to the facial nerve.
- **Cranial nerve IX:** The *glossopharyngeal nerve* arises at the groove posterior to the olive on the medulla oblongata.
- **Cranial nerve X:** The *vagus nerve* arises from the medulla oblongata by 8 to 10 rootlets between the olive and the inferior cerebellar peduncle.
- **Cranial nerve XI:** The *accessory nerve* arises from cranial rootlets from the medulla oblongata and from rootlets of the upper five cervical levels of the spinal cord.
- **Cranial nerve XII:** The *hypoglossal nerve* arises by a series of rootlets from the medulla oblongata on the ventrolateral sulcus between the pyramid and the olive.

POINT OF **DEBATE**

Some anatomists do not consider the accessory nerve a "cranial nerve" because (1) it does not arise from the brain, and (2) it enters the skull through the foramen magnum. The definition of a cranial nerve states that it should arise from the brain and exit through one of the skull foramina.

- Identify the following arteries contributing to the formation of the arterial circle of Willis (see Figs. 23.43 and 23.44, Plate 23.2):
  - The *anterior cerebral* arteries, connected by the anterior communicating artery
  - The *internal carotid* arteries, connected by posterior communicating arteries to the posterior cerebral arteries

ANATOMY **NOTE**

Common variations encountered in the formation of the circle of Willis include the following:

- Absent anterior communicating artery
- Absent posterior communicating artery
- Large posterior communicating artery
- Posterior cerebral artery arises from the internal carotid (fetal posterior cerebral artery).

DISSECTION **TIP**

- The *anterior choroidal artery* arises near the origin of the posterior communicating artery and passes posterolaterally along the optic tract.
- The *trochlear nerve* and *oculomotor nerve* pass between the superior cerebellar and posterior cerebral arteries.

- Make a midsagittal incision through the brain, separating the right from the left hemisphere.
- Identify the thalamus, hypothalamus, and the three parts of the brainstem—midbrain, pons, and medulla oblongata (see Fig. 23.45).
- Identify the corpus callosum and fornix.
- Note the lateral ventricles, which open into the third ventricle through the foramen of Monro.
- Identify the foramen of Monro (Fig. 23.46).
- Note that the third ventricle is continuous inferiorly with the cerebral aqueduct, connecting the third with the fourth ventricles.

EXAMINATION OF THE CRANIAL BASE

- Identify the tentorium cerebelli and the anterior clinoid process.
- Visualize the dura covering the trigeminal nerve as it passes into the middle cranial fossa.
- With scissors, make a small cut in the dura covering the trigeminal nerve, and pull it upward (Fig. 23.47 and Plate 23.3).
- Pull the dura covering the trigeminal nerve away from the middle cranial fossa, and expose *Meckel's cave,* the area where the trigeminal (semilunar) ganglion resides (Fig. 23.48).
- Gently dissect out the soft tissues around Meckel's (trigeminal) cave and expose the trigeminal ganglion (Fig. 23.49).
- Continue the dissection distally to the trigeminal ganglion.
- Identify the ophthalmic (V1), maxillary (V2), and mandibular (V3) divisions of the trigeminal nerve entering into the superior orbital fissure, foramen

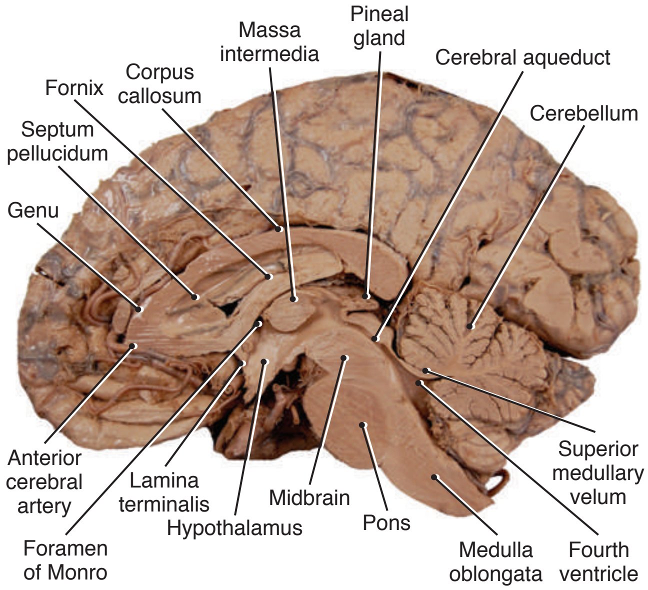

Massa intermedia
Pineal gland
Cerebral aqueduct
Fornix
Corpus callosum
Cerebellum
Septum pellucidum
Genu
Anterior cerebral artery
Lamina terminalis
Midbrain
Superior medullary velum
Hypothalamus
Pons
Foramen of Monro
Medulla oblongata
Fourth ventricle

Fig. 23.46 Sagittal section of cerebellum and brainstem.

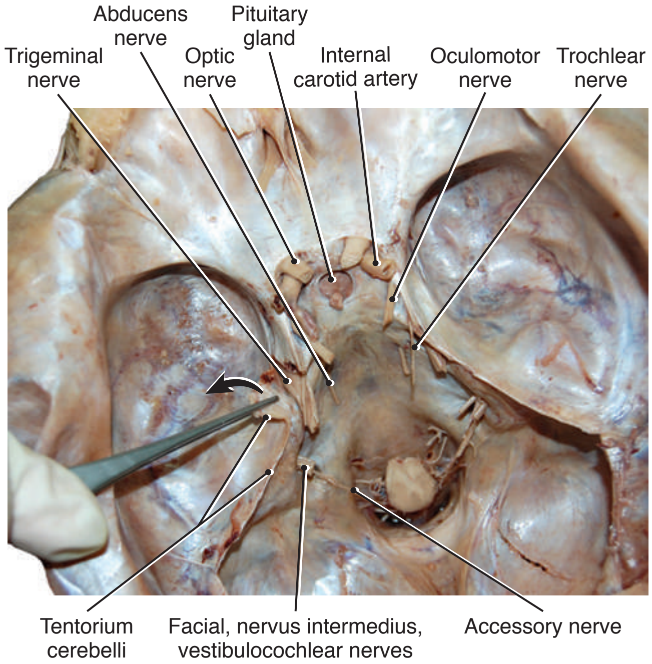
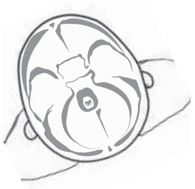

Abducens nerve
Pituitary gland
Trigeminal nerve
Optic nerve
Internal carotid artery
Oculomotor nerve
Trochlear nerve
Tentorium cerebelli
Facial, nervus intermedius, vestibulocochlear nerves
Accessory nerve

Fig. 23.47 Appreciate the tentorium cerebelli, anterior clinoid process, and dura mater covering the trigeminal nerve pulled upward.



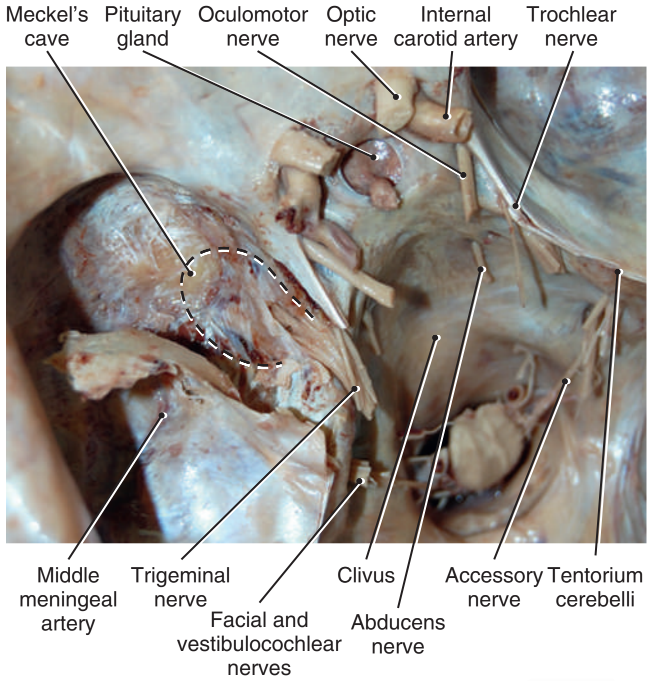

Meckel's cave
Pituitary gland
Oculomotor nerve
Optic nerve
Internal carotid artery
Trochlear nerve
Middle meningeal artery
Trigeminal nerve
Facial and vestibulocochlear nerves
Clivus
Abducens nerve
Accessory nerve
Tentorium cerebelli

Fig. 23.48 Trigeminal nerve dura pulled from middle cranial fossa, exposing pituitary gland, Meckel's cave *(dashed arch),* and clivus (bony surface of posterior cranial fossa).

rotundum, and foramen ovale, respectively (see Figs. 23.49 and 23.50).

- Continue laterally by identifying the internal carotid arteries passing underneath the optic nerves.
- Posterior to the optic chiasm and optic nerves, identify the infundibulum of the pituitary gland *(hypophysis)* and the diaphragma sella (Fig. 23.51 and Plate 23.3).
- Identify the cavernous sinus, appreciating that the walls of the cavernous sinuses are formed by dura mater.
- Identify the oculomotor nerve as it passes underneath the free edge of the tentorium toward the posterior clinoid process.
- At the posterior clinoid process, identify the trochlear nerve.
- Inferior to the sella turcica, note the *abducens nerve* penetrating the dural wall of the cavernous sinus (Fig. 23.52).
- Remove the dura from the middle cranial fossa as well as from the medial side of the cavernous sinus (Fig. 23.53).
- Separate the soft tissue around the oculomotor nerve and internal carotid artery.

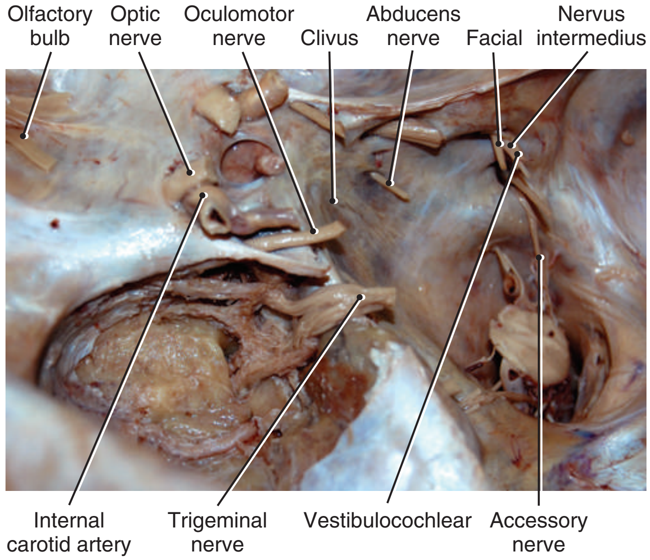
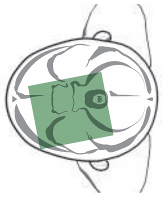

Olfactory bulb
Optic nerve
Oculomotor nerve
Clivus
Abducens nerve
Facial
Nervus intermedius
Internal carotid artery
Trigeminal nerve
Vestibulocochlear
Accessory nerve

Fig. 23.50 Anterolateral view of anterior, middle, and posterior cranial fossae.



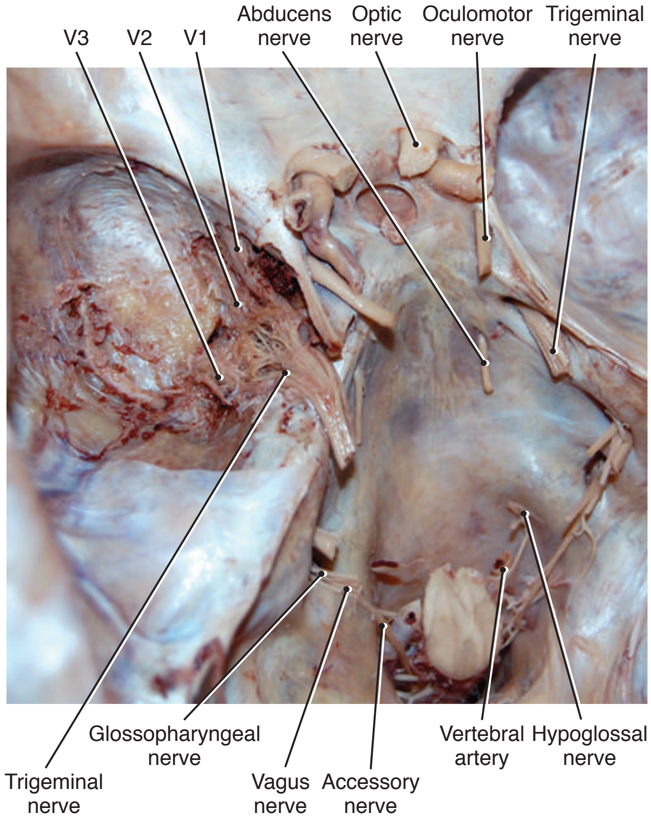

V3
V2
V1
Abducens nerve
Optic nerve
Oculomotor nerve
Trigeminal nerve
Glossopharyngeal nerve
Trigeminal nerve
Vagus nerve
Accessory nerve
Vertebral artery
Hypoglossal nerve

Fig. 23.49 Dissection continued distally to trigeminal ganglion revealing ophthalmic *(V1)*, maxillary *(V2)*, and mandibular *(V3)* divisions of trigeminal nerve and key neurovascular structures.

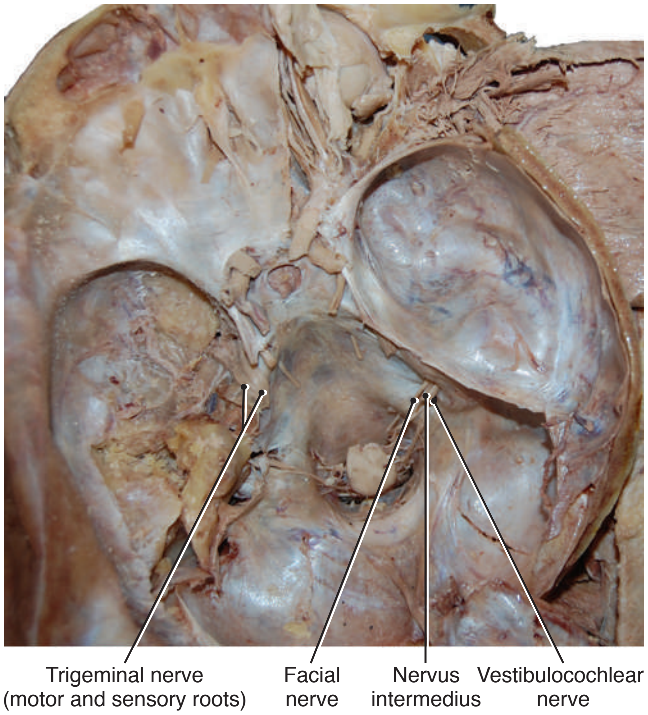
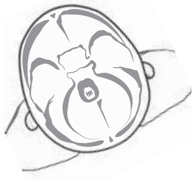

Trigeminal nerve (motor and sensory roots)
Facial nerve
Nervus intermedius
Vestibulocochlear nerve

Fig. 23.51 Appreciate foramina for trigeminal nerve branches and facial, intermediate, and vestibulocochlear nerves.



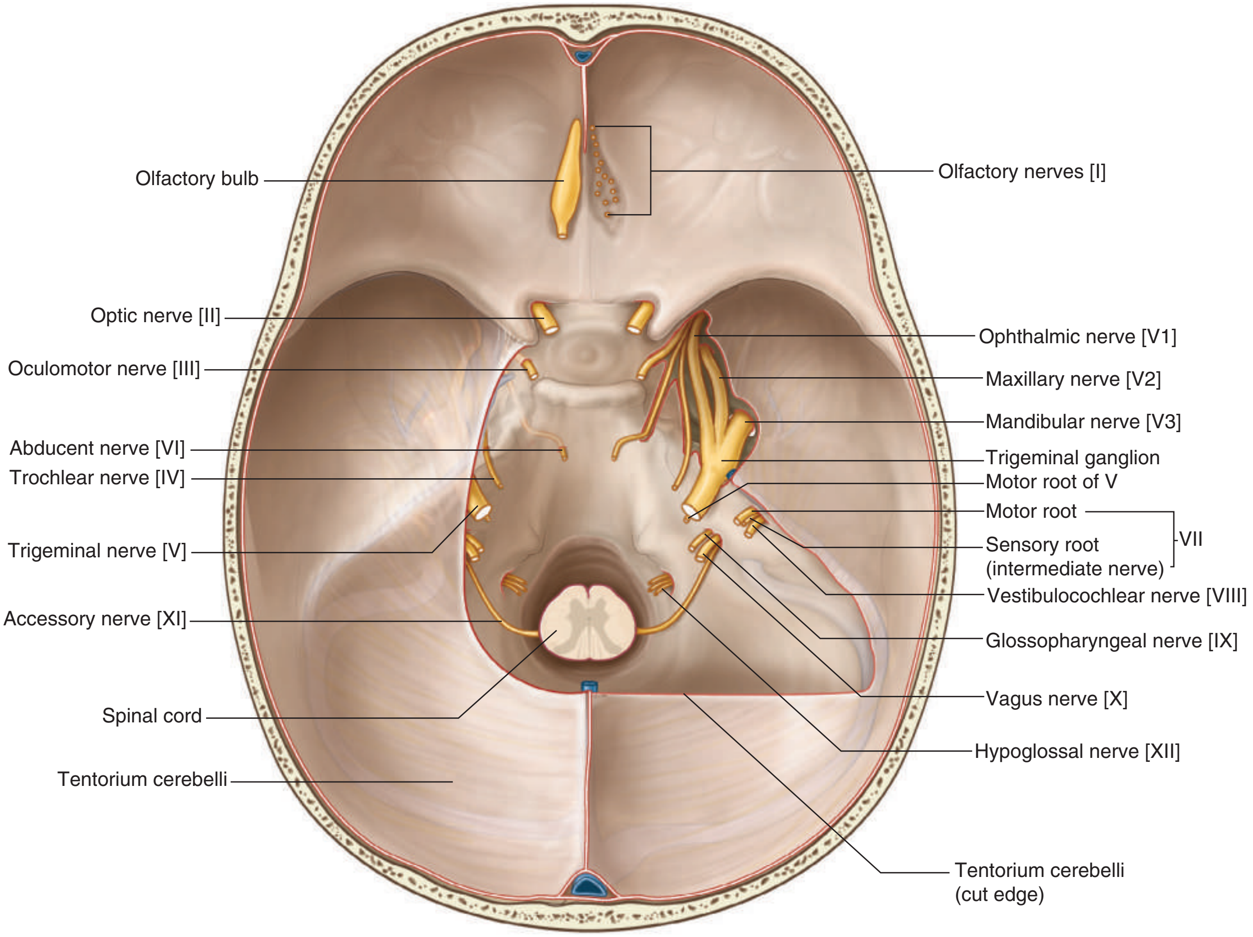

Olfactory bulb
Olfactory nerves [I]
Optic nerve [II]
Oculomotor nerve [III]
Abducent nerve [VI]
Trochlear nerve [IV]
Trigeminal nerve [V]
Accessory nerve [XI]
Spinal cord
Tentorium cerebelli
Ophthalmic nerve [V1]
Maxillary nerve [V2]
Mandibular nerve [V3]
Trigeminal ganglion
Motor root of V
Motor root
Sensory root
(intermediate nerve)
VII
Vestibulocochlear nerve [VIII]
Glossopharyngeal nerve [IX]
Vagus nerve [X]
Hypoglossal nerve [XII]
Tentorium cerebelli
(cut edge)

Plate 23.3 Cranial nerves as they traverse the cranium.

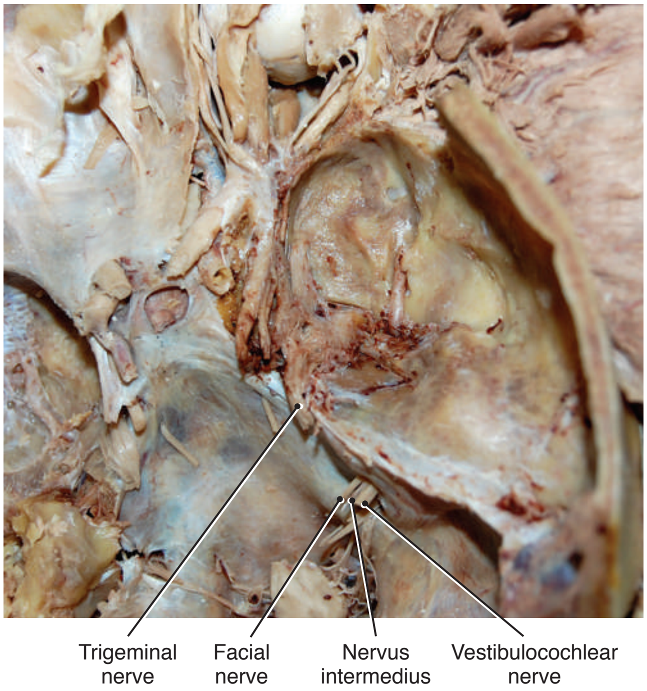

Trigeminal nerve
Facial nerve
Nervus intermedius
Vestibulocochlear nerve

Fig. 23.52 Appreciate the walls of the cavernous sinus formed by dura mater; note neurovascular foramina.

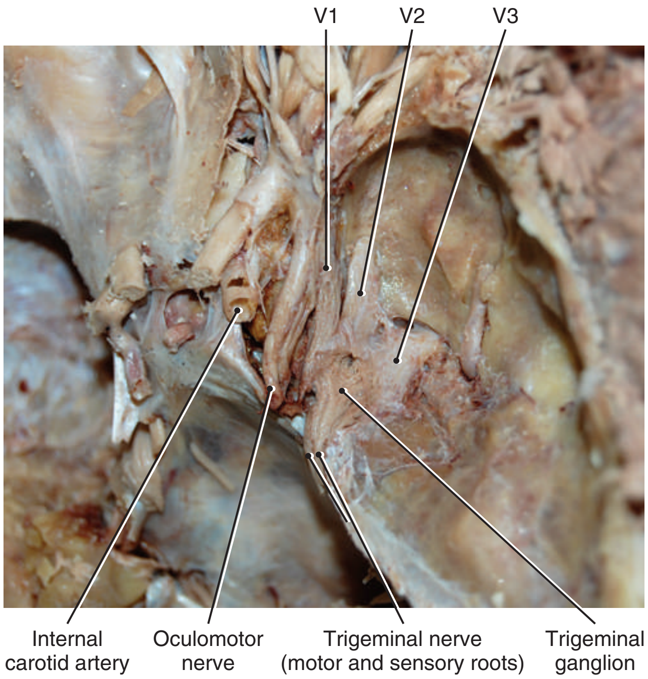

V1
V2
V3
Internal carotid artery
Oculomotor nerve
Trigeminal nerve (motor and sensory roots)
Trigeminal ganglion

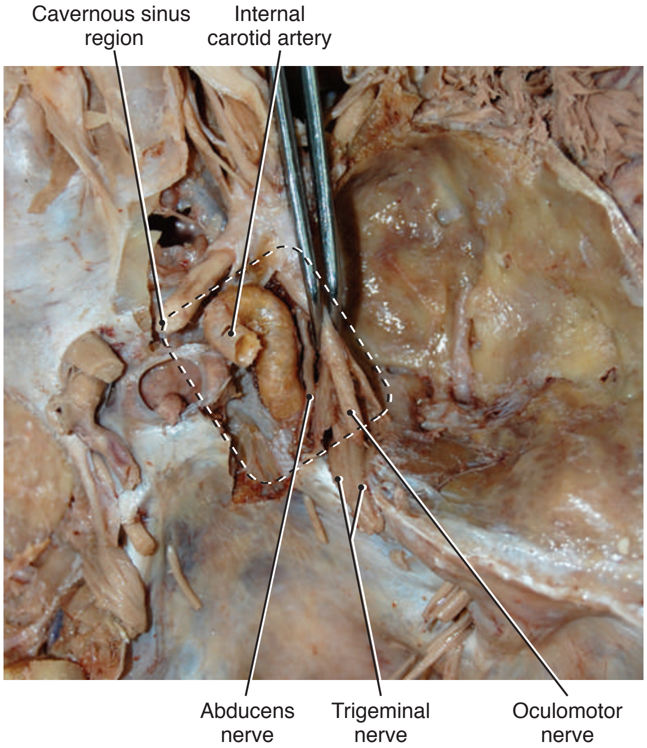
Fig. 23.53 Dura removed from middle cranial fossa and medial side of the cavernous sinus and soft tissue separated around the internal carotid artery.

- Notice the S-shaped course of the internal carotid artery (carotid siphon) within the cavernous sinus.
- Identify the abducens nerve running lateral to the internal carotid artery within the cavernous sinus.
- Incise the dura at the entrance of the abducens nerve, and follow it into the cavernous sinus.

ANATOMY **NOTE**

The internal carotid artery and the abducens nerve are covered by a layer that separates them from adjacent venous blood (Fig. 23.54).

- Identify the sigmoid sinus, and cut open the dura that covers it.
- Pull the dura covering off the superior and inferior petrosal sinuses.
- Identify the internal acoustic meatus, and trace the facial and vestibulocochlear nerves as they enter the foramen.
- Look inferior to the internal acoustic meatus for the jugular foramen, and trace the glossopharyngeal, vagus, and accessory nerves (see Figs. 23.47 and 23.51).
- Note the upper cervical spinal fibers of the accessory nerve entering through the foramen magnum. Inferior to the jugular foramen and superior to the foramen magnum, identify the hypoglossal canal with the hypoglossal nerve (see Figs. 23.47 and 23.51).



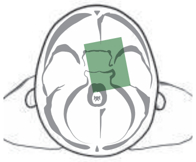


Fig. 23.54 Dashed lines indicate cavernous sinus region with abducens nerve running lateral to internal carotid artery.

LABORATORY IDENTIFICATION CHECKLIST

BRAIN/BRAINSTEM

- ☐ Frontal lobe
  - ☐ Precentral gyrus
- ☐ Central sulcus
- ☐ Parietal lobe
  - ☐ Postcentral gyrus
- ☐ Occipital lobe
  - ☐ Occipital lobe gyri
- ☐ Temporal lobe
  - ☐ Temporal lobe gyri
- ☐ Corpus callosum
  - ☐ Genu
- ☐ Septum pellucidum
- ☐ Fornix
- ☐ Midbrain
- ☐ Hypothalamus
- ☐ Lamina terminalis
- ☐ Pineal gland
- ☐ Medulla oblongata
- ☐ Fourth ventricle
- ☐ Pons
- ☐ Mammillary body
- ☐ Foramen of Monro
- ☐ Cerebral aqueduct
- ☐ Pituitary stalk/gland
- ☐ Cerebellum

NERVES

- ☐ Olfactory bulb
- ☐ Olfactory tract
- ☐ Optic nerve
- ☐ Optic chiasm
- ☐ Oculomotor nerve
- ☐ Trochlear nerve
- ☐ Trigeminal nerve
  - ☐ V1 (ophthalmic) division
  - ☐ V2 (maxillary) division
  - ☐ V3 (mandibular) division
- ☐ Abducens nerve
- ☐ Facial nerve
- ☐ Nervus intermedius
- ☐ Vestibulocochlear nerve
- ☐ Glossopharyngeal nerve
- ☐ Vagus nerve
- ☐ Accessory nerve
- ☐ Hypoglossal nerve

ARTERIES

- ☐ Internal carotid
- ☐ Basilar
- ☐ Middle meningeal
  - ☐ Anterior branch
  - ☐ Posterior branch
- ☐ Superficial temporal
- ☐ Anterior cerebral
- ☐ Middle cerebral
- ☐ Posterior cerebral
- ☐ Posterior communicating
- ☐ Vertebral

VEINS/SINUSES

- ☐ Confluence of sinuses
- ☐ Superior sagittal sinus
- ☐ Inferior sagittal sinus
- ☐ Transverse sinus
- ☐ Straight sinus
- ☐ Emissary veins
- ☐ Superficial cerebral veins
- ☐ Cavernous sinus

MUSCLE

- ☐ Temporalis

CONNECTIVE TISSUE

- ☐ Skin
- ☐ Subcutaneous tissue
- ☐ Epicranial aponeurosis
- ☐ Dura mater
- ☐ Lateral lacunae
- ☐ Falx cerebri
- ☐ Tentorium cerebelli
- ☐ Arachnoid mater
- ☐ Pia mater
- ☐ Temporalis fascia
- ☐ Parotid fascia

BONES/FOSSAE/SINUSES

- ☐ Frontal bone
  - ☐ Frontal sinus
  - ☐ Supraorbital notch/foramen
  - ☐ Glabella

- ☐ Ethmoid bone
    - ☐ Crista galli
- ☐ Temporal bone
- ☐ Parietal bone
- ☐ Occipital bone
    - ☐ Internal occipital crest
    - ☐ Inion
    - ☐ Superior nuchal line
- ☐ Zygomatic arch
- ☐ Diploic space
- ☐ Pterion
- ☐ Sagittal suture
- ☐ Lambdoid suture
- ☐ Parietal foramen
- ☐ Temporal fossa
- ☐ Anterior cranial fossa
- ☐ Middle cranial fossa
- ☐ Posterior cranial fossa
- ☐ Retromandibular region

CHAPTER 24 ORBIT

ATLAS REFERENCES

Netter: 94–104
McMinn: 54–57
Gray's Atlas: 508–519

BEFORE YOU BEGIN

Remove all soft tissues with a scalpel and expose the frontal and temporal bones. Reflect the temporalis muscle as laterally as possible.

OSTEOTOMY OF ORBITAL ROOF

- **With an electric saw or a mallet and chisel, make a second vertical cut through the frontal bone, lateral to the supraorbital notch (Fig. 24.1).**
- **Extend this cut posteriorly through the roof of the orbit between the optic nerve and ethmoidal sinuses (Fig. 24.2).**
- **With an electric saw or a mallet and chisel, make a second vertical cut through the squamous part of the temporal bone.**
- **Continue the cut horizontally toward the orbital process of the zygomatic bone at the infraorbital margin (see Fig. 24.2).**

DISSECTION **TIP**

Once all bones are cut, the orbital roof and the orbital process of the zygomatic bone can be reflected en bloc, while the periorbita (periosteal covering of orbital bones) is left intact (Fig. 24.3). This is referred to as an *orbito-zygomatic approach.*

- **Complete the reflection of the orbital roof anteriorly but do not detach it from the orbit (Fig. 24.4).**

ORBIT

- **With sharp scissors, make a small cut in the periorbital fascia (Fig. 24.5).**
- **Identify the frontal nerve and its two branches, the supraorbital and supratrochlear nerves (Fig. 24.6).**
- **Clean and expose the frontal nerve and note the levator palpebrae superioris muscle lying underneath it (Fig. 24.7).**
- **Lateral and inferior to the levator palpebrae superioris, expose the superior rectus muscle (Fig. 24.8).**
- **Medial to the levator palpebrae superioris muscle, remove a small portion of the periorbital fat and identify the *nasociliary nerve* (Fig. 24.9 and Plate 24.1).**

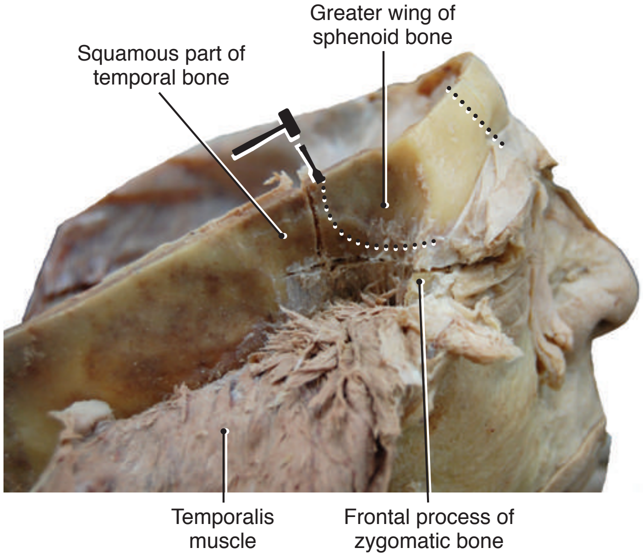
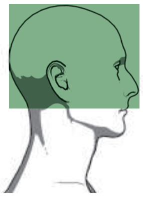

Greater wing of sphenoid bone
Squamous part of temporal bone
Temporalis muscle
Frontal process of zygomatic bone

Fig. 24.1 Anterolateral view of external orbit after craniotomy, with reflected temporalis muscle revealing bony landmarks; *dotted lines* indicate cuts through the frontal bone and orbital roof.



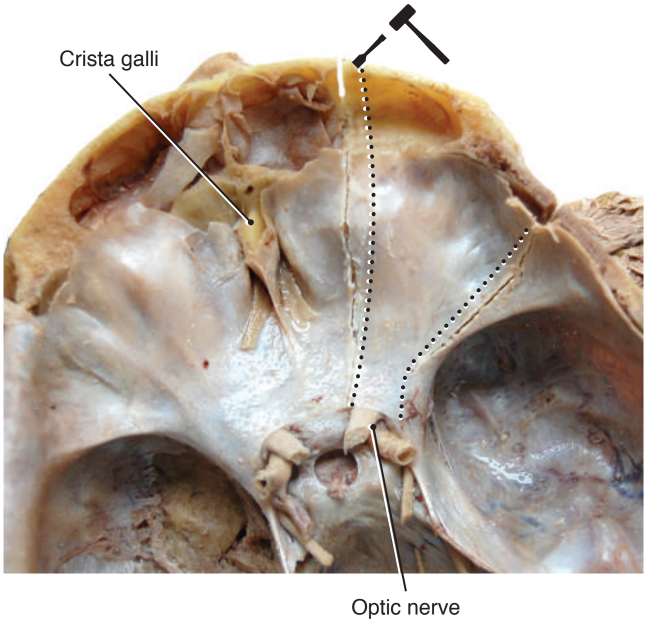


Fig. 24.2 Craniotomy view of anterior cranial fossa, or superior roof of the orbit; *dotted lines* over dura represent osteotomy cuts.

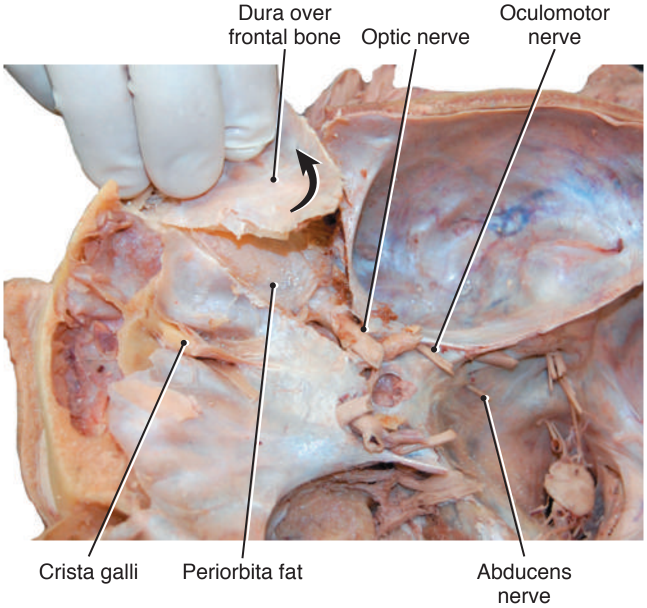

Dura over frontal bone
Optic nerve
Oculomotor nerve
Crista galli
Periorbita fat
Abducens nerve

Fig. 24.3 Craniotomy view highlighting anterior cranial fossa and dura mater, periorbital fat, crista galli, frontal bone, and nerves (optic, oculomotor, abducens).

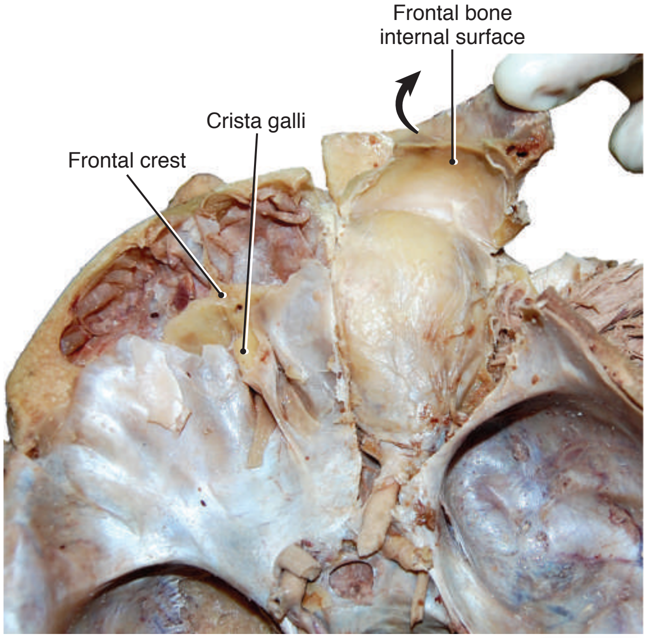

Frontal bone internal surface
Crista galli
Frontal crest

Fig. 24.4 Craniotomy view of anterior cranial fossa with osteotomy performed to the roof of right orbit.

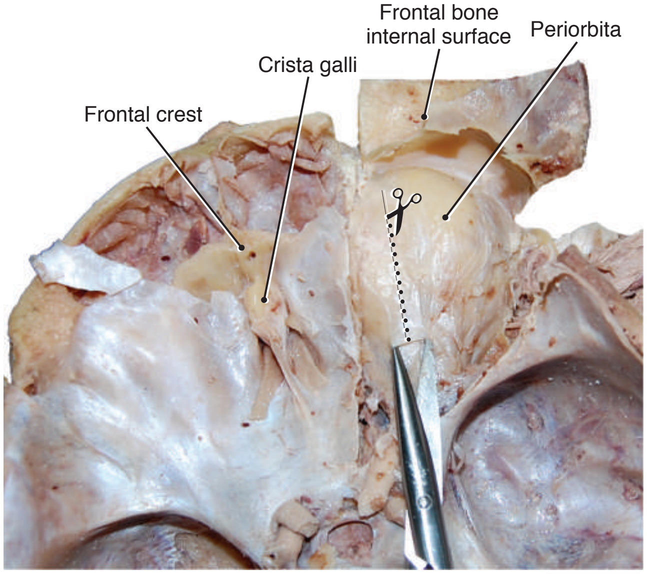

Frontal bone internal surface
Periorbita
Crista galli
Frontal crest

Fig. 24.5 Craniotomy view of anterior cranial fossa with osteotomy to roof of right orbit, revealing scissors cutting periorbita.

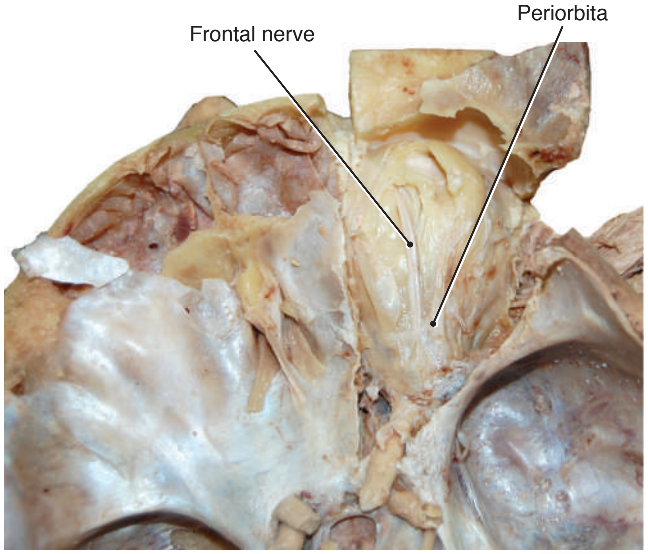

Periorbita
Frontal nerve

Fig. 24.6 Craniotomy view of the anterior cranial fossa with osteotomy to orbital roof.

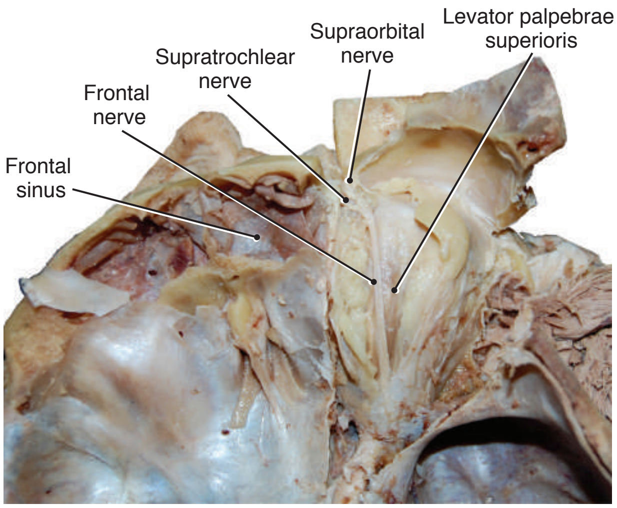

Supraorbital nerve
Levator palpebrae superioris
Supratrochlear nerve
Frontal nerve
Frontal sinus

Fig. 24.7 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit.

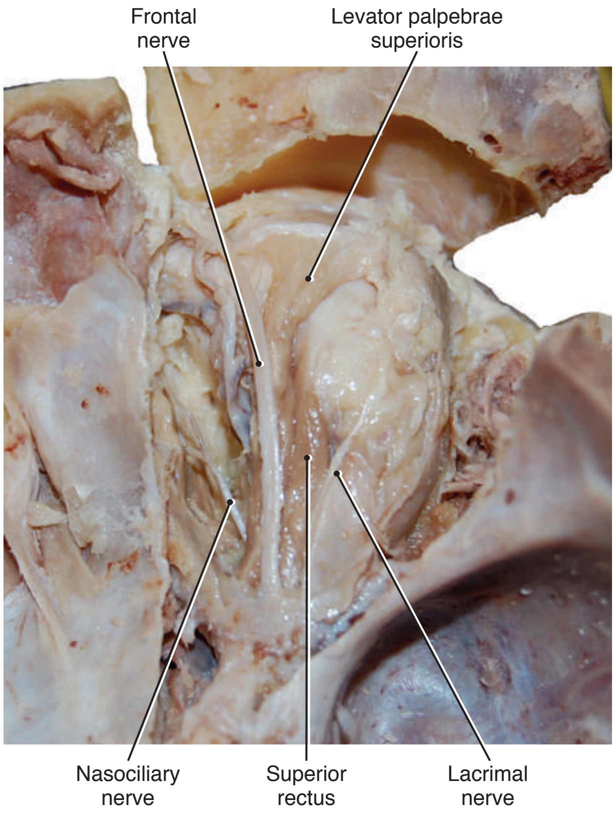

Frontal nerve
Levator palpebrae superioris
Nasociliary nerve
Superior rectus
Lacrimal nerve

Fig. 24.8 Craniotomy view of anterior cranial fossa with orbital roof osteotomy, revealing neurovascular landmarks.

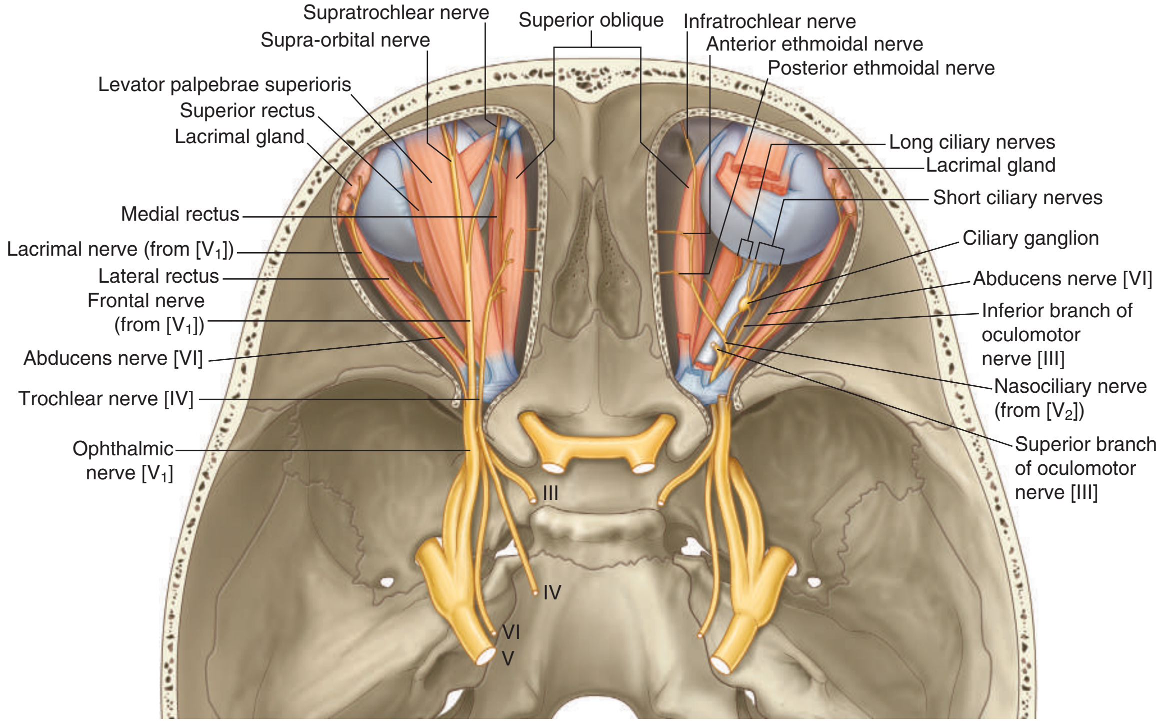

Supratrochlear nerve
Supra-orbital nerve
Superior oblique
Infratrochlear nerve
Anterior ethmoidal nerve
Posterior ethmoidal nerve
Levator palpebrae superioris
Superior rectus
Lacrimal gland
Long ciliary nerves
Lacrimal gland
Short ciliary nerves
Medial rectus
Ciliary ganglion
Lacrimal nerve (from [V$_1$])
Abducens nerve [VI]
Lateral rectus
Inferior branch of oculomotor nerve [III]
Frontal nerve (from [V$_1$])
Abducens nerve [VI]
Nasociliary nerve (from [V$_2$])
Trochlear nerve [IV]
Superior branch of oculomotor nerve [III]
Ophthalmic nerve [V$_1$]
III
IV
VI
V

Plate 24.1 Superior view of the nerves and musculature of the orbit.

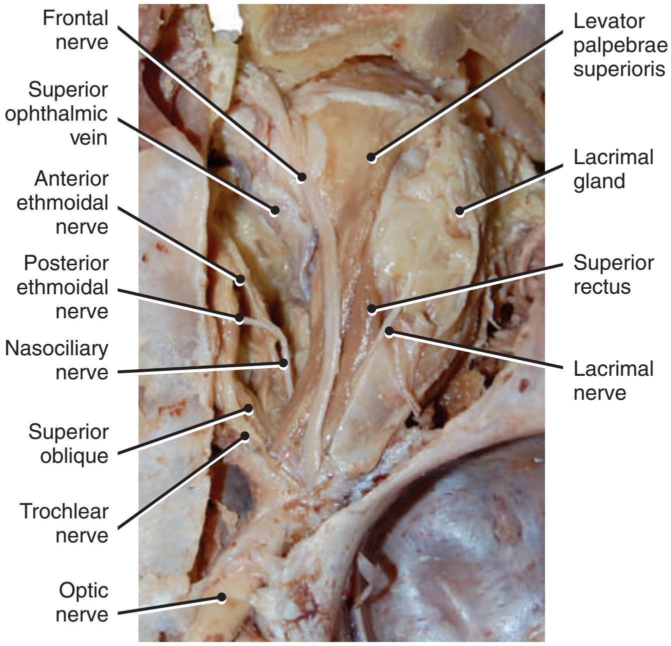

Frontal nerve
Superior ophthalmic vein
Anterior ethmoidal nerve
Posterior ethmoidal nerve
Nasociliary nerve
Superior oblique
Trochlear nerve
Optic nerve
Levator palpebrae superioris
Lacrimal gland
Superior rectus
Lacrimal nerve

Fig. 24.9 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit highlighting neurovascular musculature.

ANATOMY **NOTE**

The nasociliary nerve is located in the interval between the levator palpebrae superioris and the superior oblique muscles and crosses the optic nerve from lateral to medial (see Fig. 24.9).

- Trace the terminal branches of the nasociliary nerve—the posterior ethmoidal, anterior ethmoidal, and infratrochlear nerves.

DISSECTION **TIP**

The branches of the nasociliary nerve are small and delicate. The infratrochlear nerve is especially delicate and easily severed during dissection. The posterior ethmoidal nerve is often absent.

- The superior oblique muscle is usually hidden medially under the orbital roof. Break away portions of the orbital roof to identify and clean the superior oblique muscle.
- Clean the periorbital fat around the superior oblique muscle, and note the *trochlear nerve* entering the superior surface of the muscle proximally (see Fig. 24.9).
- Distal to the interval between the superior oblique and levator palpebrae superioris muscles, look for a flat vessel, the superior ophthalmic vein.
- Remove all small tributaries of the ophthalmic veins (see Fig. 24.9).

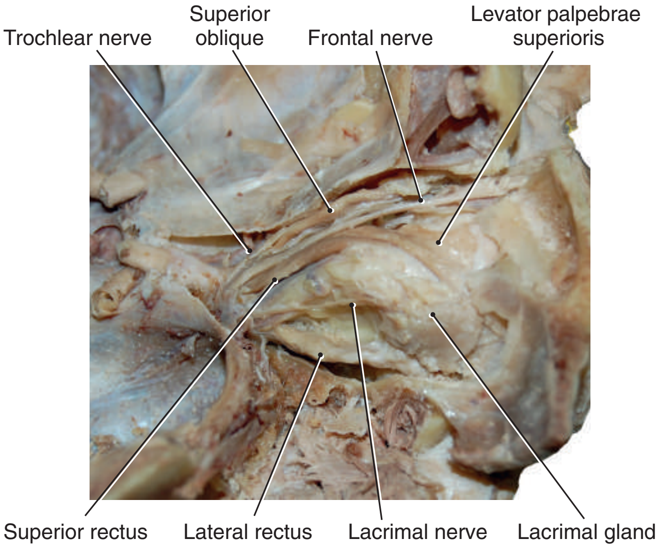
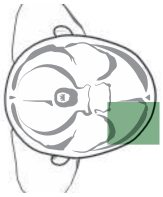

Trochlear nerve
Superior oblique
Frontal nerve
Levator palpebrae superioris
Superior rectus
Lateral rectus
Lacrimal nerve
Lacrimal gland

Fig. 24.10 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit highlighting neurovascular musculature.



- On the lateral surface of the superior rectus muscle, trace and expose the lacrimal nerve and lacrimal gland (see Fig. 24.9).

DISSECTION **TIP**

The lacrimal gland is located distally and is often confused with periorbital fat. Lift and pull up on the lacrimal nerve to trace it to the lacrimal gland.

- Deep to the lacrimal nerve, expose the lateral rectus muscle (Fig. 24.10).
- Pull the lateral rectus muscle laterally, and expose the *abducens nerve* on its medial side (Fig. 24.11).
- Look for the *superior ophthalmic vein* in the space between the superior rectus and lateral rectus muscles (Fig. 24.12).
- After identifying the superior ophthalmic vein, remove the periorbital fat between the superior and lateral rectus muscles (Fig. 24.13).
- Observe the optic nerve, surrounded by short and long ciliary nerves (Fig. 24.14).
- Identify the *ciliary ganglion* on the lateral surface of the optic nerve and medial to the lateral rectus muscle (see Fig. 24.14).

DISSECTION **TIP**

Another important landmark is the ciliary ganglion. It is connected by a small branch (motor root of ciliary ganglion) with the inferior division of the oculomotor nerve. The ganglion may be confused with periorbital fat.

- At the interval between the optic nerve and the lateral rectus muscle, identify the *ophthalmic artery* (Fig. 24.15).

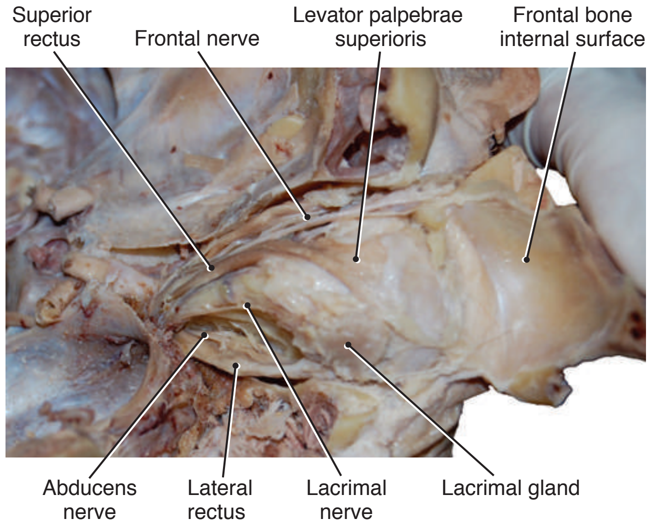
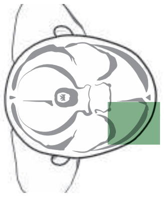

Superior rectus
Frontal nerve
Levator palpebrae superioris
Frontal bone internal surface
Abducens nerve
Lateral rectus
Lacrimal nerve
Lacrimal gland

Fig. 24.11 Craniotomy view of anterior cranial fossa with orbital osteotomy.



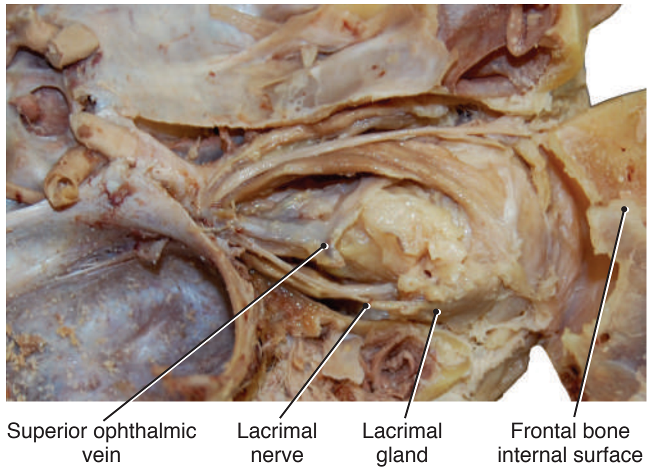
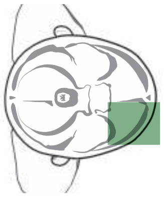

Superior ophthalmic vein
Lacrimal nerve
Lacrimal gland
Frontal bone internal surface

Fig. 24.12 Craniotomy view of anterior cranial fossa with osteotomy to orbital roof, highlighting superior ophthalmic vein.



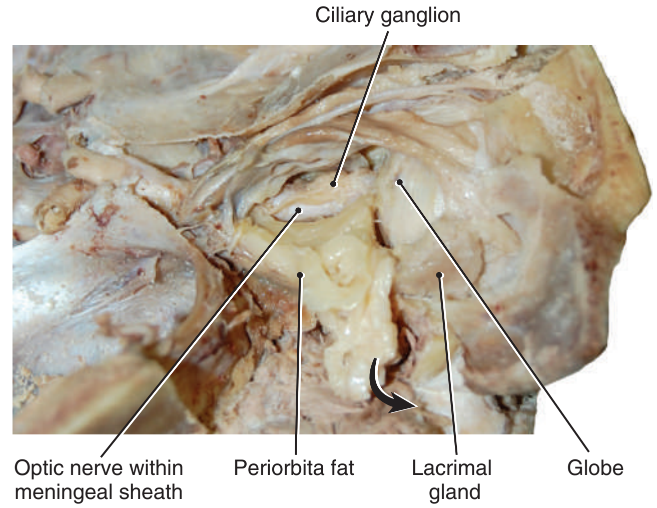
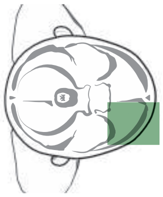

Ciliary ganglion
Optic nerve within meningeal sheath
Periorbita fat
Lacrimal gland
Globe

Fig. 24.13 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit.



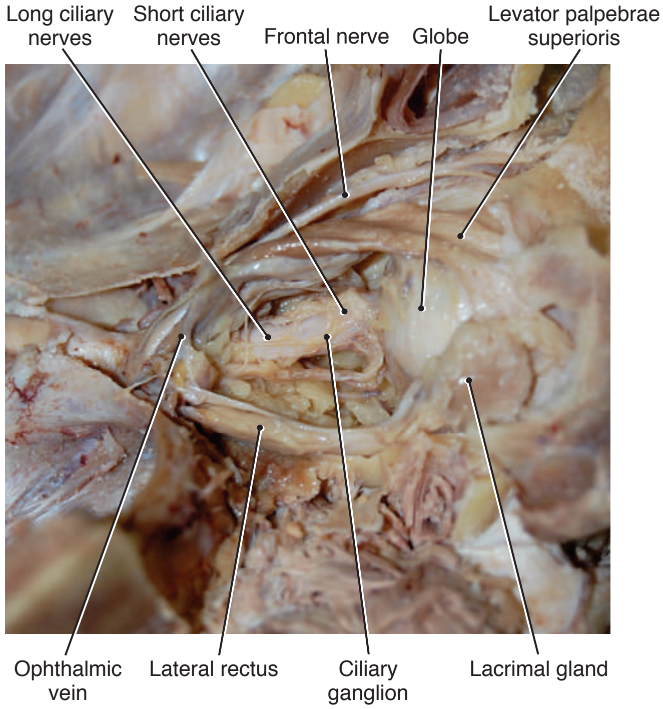
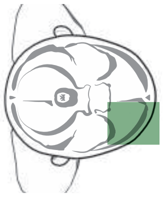

Long ciliary nerves
Short ciliary nerves
Frontal nerve
Globe
Levator palpebrae superioris
Ophthalmic vein
Lateral rectus
Ciliary ganglion
Lacrimal gland

Fig. 24.14 Craniotomy view of anterior cranial fossa with osteotomy to orbital roof, revealing frontal nerve, reflected levator palpebrae superioris muscle, and highlighting long and short ciliary nerves and ciliary ganglion.



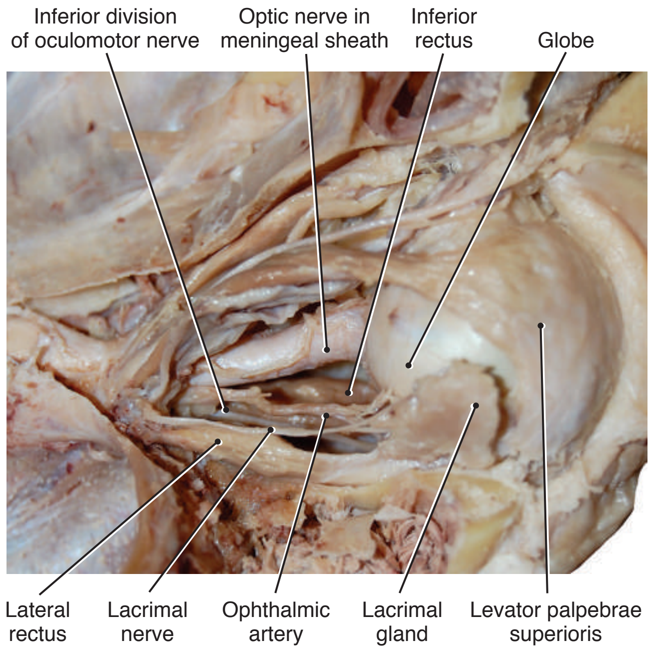
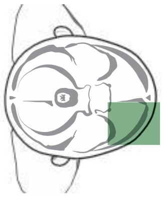

Inferior division of oculomotor nerve
Optic nerve in meningeal sheath
Inferior rectus
Globe
Lateral rectus
Lacrimal nerve
Ophthalmic artery
Lacrimal gland
Levator palpebrae superioris

Fig. 24.15 Craniotomy view of anterior cranial fossa with osteotomy.



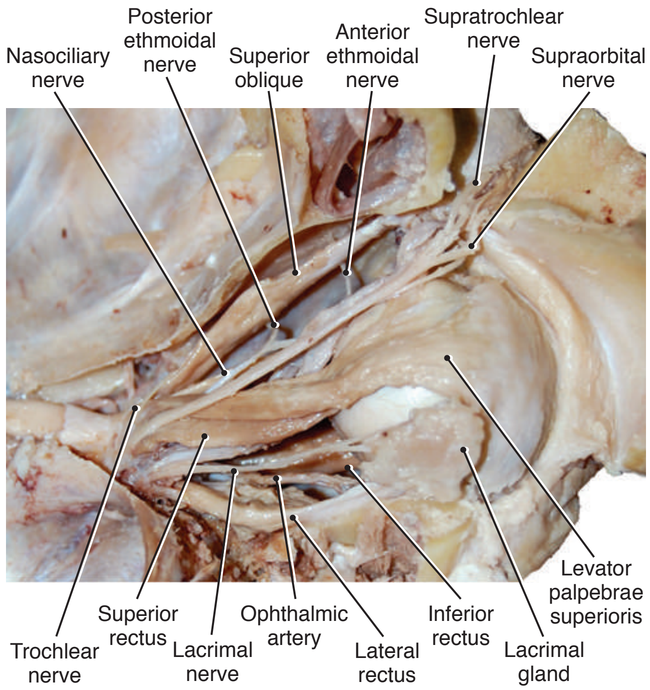
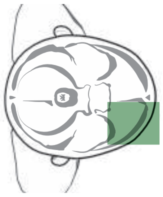

Nasociliary nerve
Posterior ethmoidal nerve
Superior oblique
Anterior ethmoidal nerve
Supratrochlear nerve
Supraorbital nerve
Levator palpebrae superioris
Trochlear nerve
Superior rectus
Lacrimal nerve
Ophthalmic artery
Lateral rectus
Inferior rectus
Lacrimal gland

Fig. 24.16 Craniotomy view of anterior cranial fossa with osteotomy to orbital roof.



ANATOMY **NOTE**

After entering the orbit, the ophthalmic artery gives off a central retinal branch to the optic nerve and usually crosses over the nerve and passes toward the medial wall of the orbit.

- **Inferior to the optic nerve, remove the periorbital fat and identify the inferior division of the oculomotor nerve, which runs parallel to the inferior rectus muscle (see Fig. 24.15).**
- **Clean the periorbital fat inferior to the superior oblique muscle.**
- **Trace the anterior and posterior ethmoidal nerves to their entrance into the anterior and posterior ethmoidal foramina, respectively (Fig. 24.16 and Plate 24.2).**

ANATOMY **NOTE**

The four recti muscles arise from a fibrous ring that encircles the optic foramen and a portion of the superior orbital fissure. The superior oblique and levator palpebrae muscles arise from points superior and medial to this anulus (anulus of Zinn) (Fig. 24.17).

- **Reflect the nasociliary nerve and ophthalmic artery posteriorly and expose the medial rectus muscle (Fig. 24.18).**

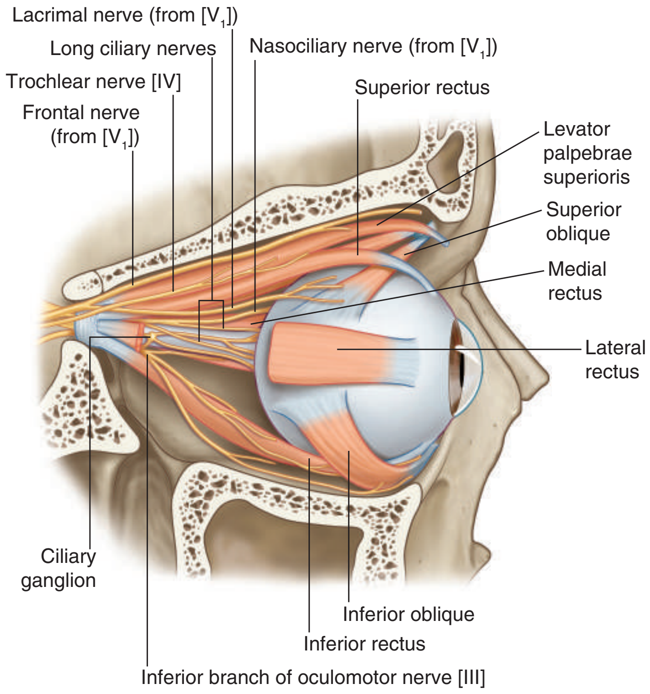

Lacrimal nerve (from [V_1])
Long ciliary nerves
Nasociliary nerve (from [V_1])
Trochlear nerve [IV]
Superior rectus
Frontal nerve (from [V_1])
Levator palpebrae superioris
Superior oblique
Medial rectus
Lateral rectus
Ciliary ganglion
Inferior oblique
Inferior rectus
Inferior branch of oculomotor nerve [III]

Plate 24.2 Lateral view of the nerves and musculature of the orbit.

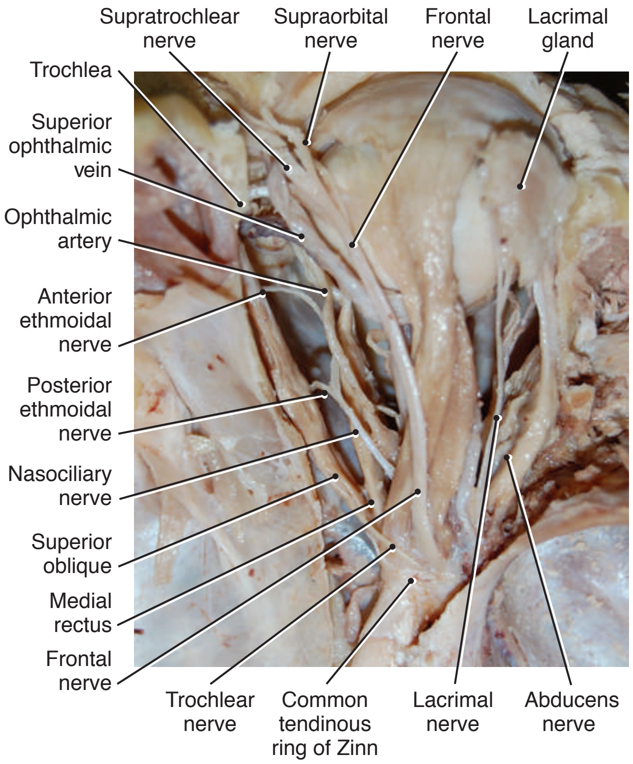

Supratrochlear nerve
Supraorbital nerve
Frontal nerve
Lacrimal gland
Trochlea
Superior ophthalmic vein
Ophthalmic artery
Anterior ethmoidal nerve
Posterior ethmoidal nerve
Nasociliary nerve
Superior oblique
Medial rectus
Frontal nerve
Trochlear nerve
Common tendinous ring of Zinn
Lacrimal nerve
Abducens nerve

Fig. 24.17 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit.

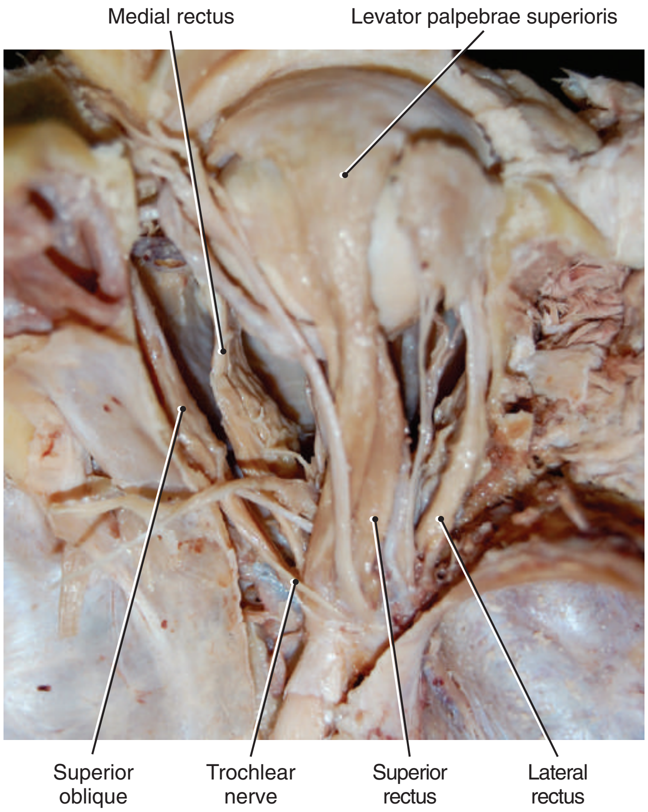

Medial rectus
Levator palpebrae superioris
Superior oblique
Trochlear nerve
Superior rectus
Lateral rectus

Fig. 24.18 Craniotomy view revealing trochlear nerve and key muscles.

- Pull the lateral rectus muscle laterally and the optic nerve medially, and expose the inferior rectus muscle (Fig. 24.19 and Plate 24.3).

DISSECTION TIP

To trace the inferior oblique muscle, the inferior rectus muscle, and the nerve to the inferior oblique muscle, you need to dissect inferior to the globe.

INFRAORBITAL APPROACH

- Detach the orbital septum from the infraorbital margin.
- Lift the orbit and periorbital fat superiorly (Fig. 24.20).
- Clean away the periorbital fat, and expose the inferior oblique muscle running obliquely from lateral to medial (Fig. 24.21).
- Remove all periorbital fat, and identify the inferior rectus muscle and the nerve to the inferior oblique muscle (Fig. 24.22).
- Lift the orbicularis oculi muscle and identify the medial palpebral ligament (Fig. 24.23).
- Reflect all musculature from the frontal process of the maxilla (Fig. 24.24).

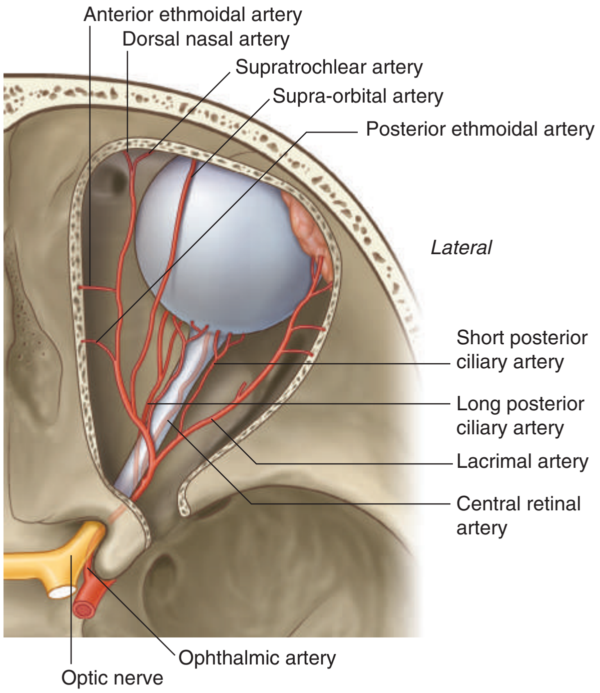

Anterior ethmoidal artery
Dorsal nasal artery
Supratrochlear artery
Supra-orbital artery
Posterior ethmoidal artery
Lateral
Short posterior ciliary artery
Long posterior ciliary artery
Lacrimal artery
Central retinal artery
Ophthalmic artery
Optic nerve

Plate 24.3 Superior view of the arteries of the orbit.

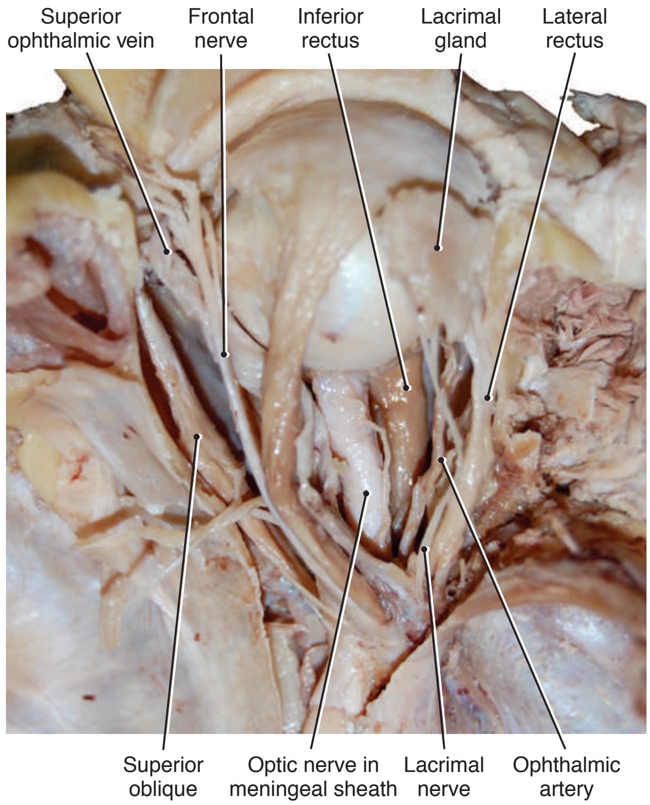

Superior ophthalmic vein
Frontal nerve
Inferior rectus
Lacrimal gland
Lateral rectus
Superior oblique
Optic nerve in meningeal sheath
Lacrimal nerve
Ophthalmic artery

Fig. 24.19 Craniotomy view of anterior cranial fossa with osteotomy to roof of orbit revealing frontal nerve, ophthalmic vein, optic nerve, lacrimal nerve, and lacrimal gland.

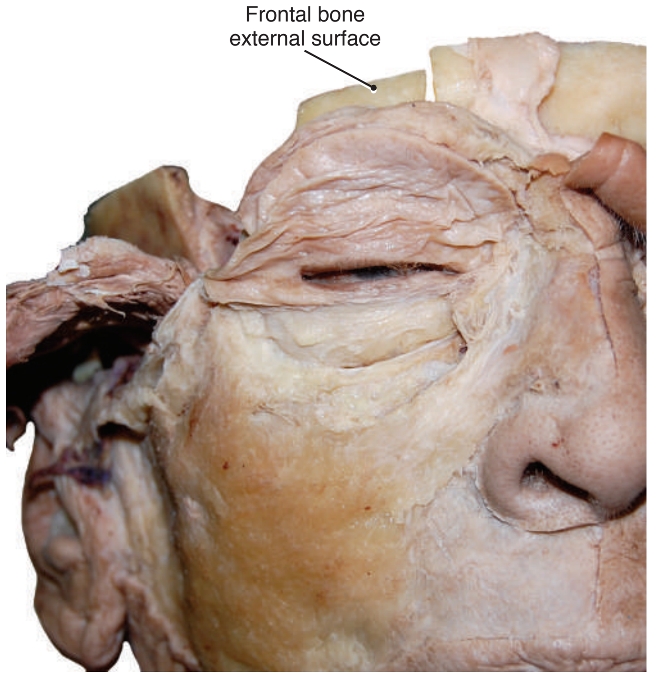

Frontal bone external surface

Fig. 24.20 Anterior view of external orbit with craniotomy and vertical frontal bone osteotomy.

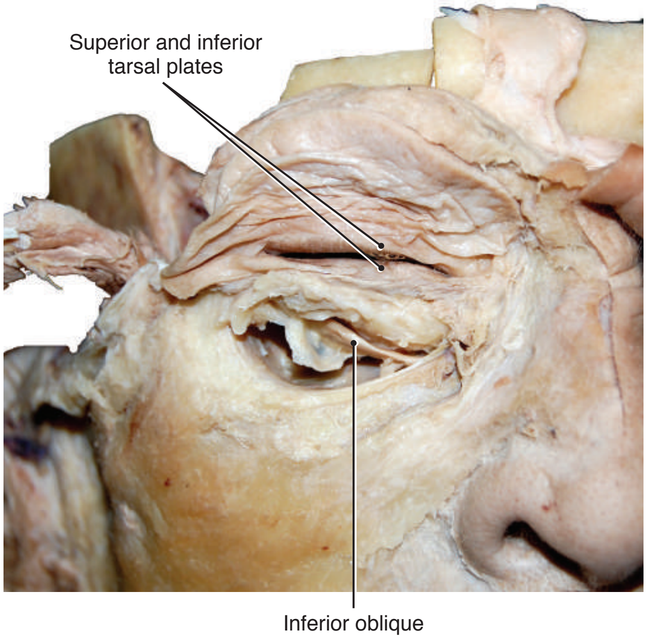

Superior and inferior tarsal plates
Inferior oblique

Fig. 24.21 Anterior view of external orbit with craniotomy showing infraorbital approach, highlighting tarsal plates.

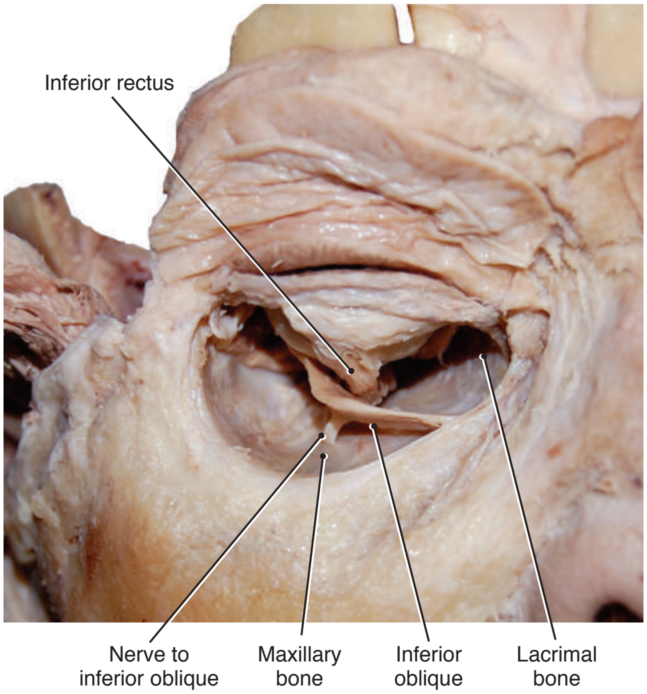
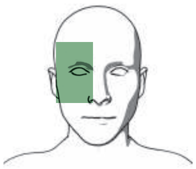

Inferior rectus
Nerve to inferior oblique
Maxillary bone
Inferior oblique
Lacrimal bone

Fig. 24.22 Anterior view of orbit with eyeball removed.



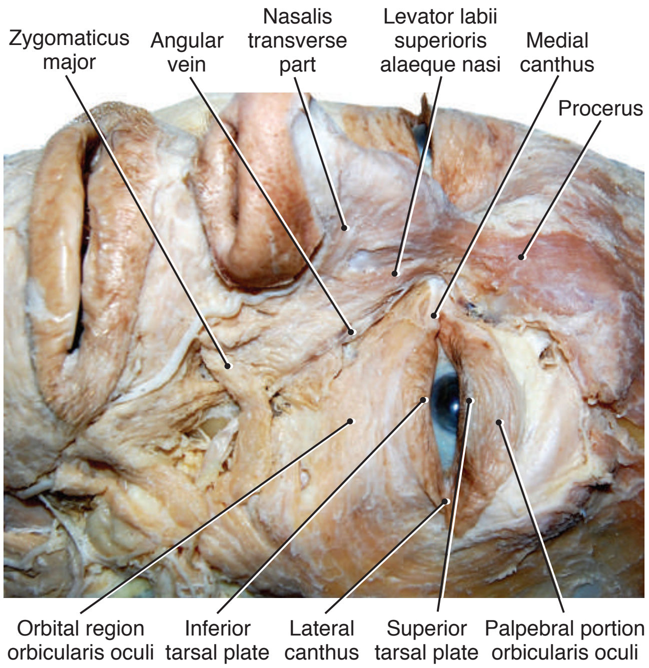

Zygomaticus major
Angular vein
Nasalis transverse part
Levator labii superioris alaeque nasi
Medial canthus
Procerus
Orbital region orbicularis oculi
Inferior tarsal plate
Lateral canthus
Superior tarsal plate
Palpebral portion orbicularis oculi

Fig. 24.23 Anterior view of external orbit with skin reflected superiorly, revealing canthi, tarsal plates, angular vein, and key muscles.

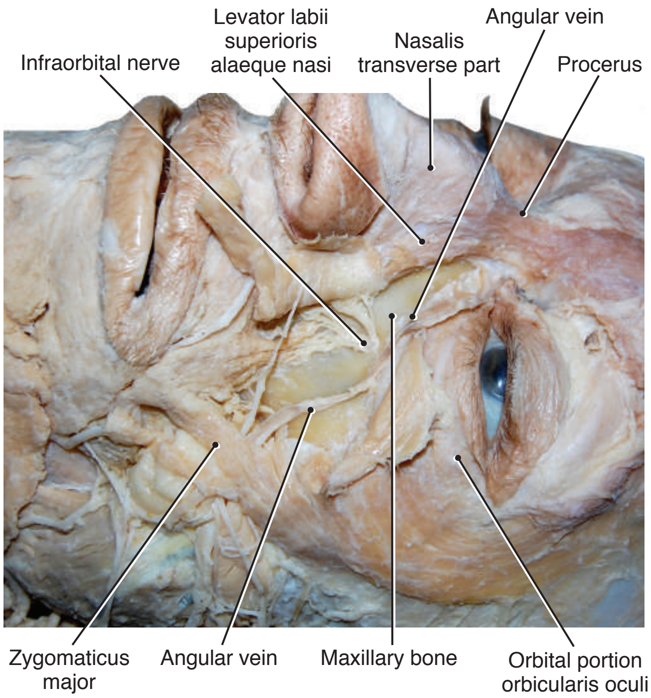

Levator labii superioris alaeque nasi
Angular vein
Infraorbital nerve
Nasalis transverse part
Procerus
Zygomaticus major
Angular vein
Maxillary bone
Orbital portion orbicularis oculi

Fig. 24.24 Anterior view of external orbit, nose, and maxilla.

- With an electric saw, cut the area inferior to the medial canthus and the inferomedial portion of the infraorbital margin (Fig. 24.25).
- Identify the nasolacrimal duct within the lacrimal canal (Fig. 24.26 and Plate 24.4).

ANATOMY **NOTE**

Excess lacrimal fluid is drained by the *puncta* into *canaliculi,* which drain the fluid to the lacrimal sac. From this sac, the nasolacrimal duct passes into the nasal cavity.

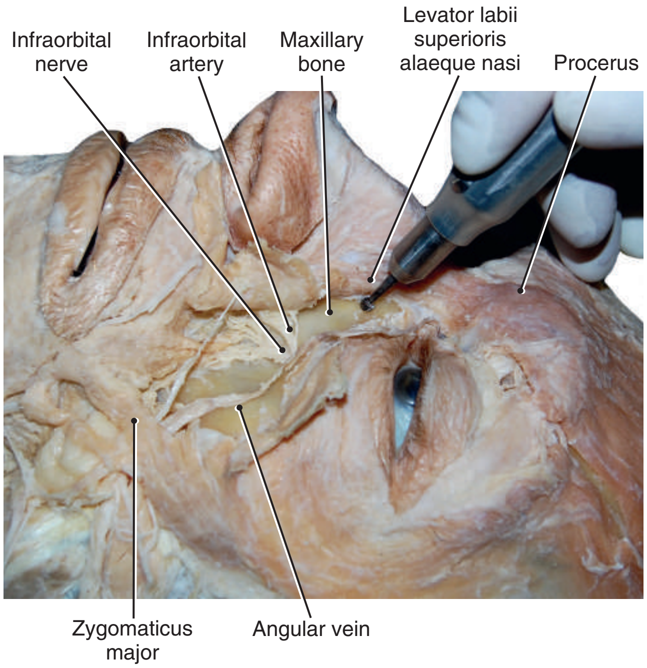

Infraorbital nerve
Infraorbital artery
Maxillary bone
Levator labii superioris alaeque nasi
Procerus
Zygomaticus major
Angular vein

Fig. 24.25 Anterolateral view of orbit with skin and subcutaneous tissue removed and orbital part of orbicularis oculi muscle reflected.

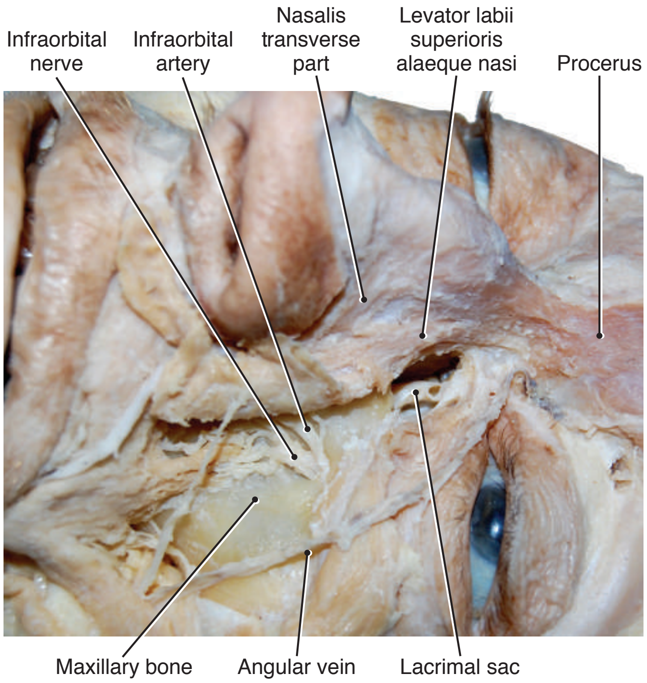

Infraorbital nerve
Infraorbital artery
Nasalis transverse part
Levator labii superioris alaeque nasi
Procerus
Maxillary bone
Angular vein
Lacrimal sac

Fig. 24.26 Anterior view of external orbit, highlighting medial region with skin and subcutaneous tissue removed.

- If time permits, remove the eyeball en bloc with the surrounding extraocular muscles (Fig. 24.27).

DISSECTION **TIP**

The sclera is usually compressed and distorted. To restore its original shape, inject water into the eyeball with a hypodermic needle attached to a syringe (Fig. 24.28). Once the shape of the *sclera* has been restored, observe its extraocular muscle attachments (Fig. 24.29).

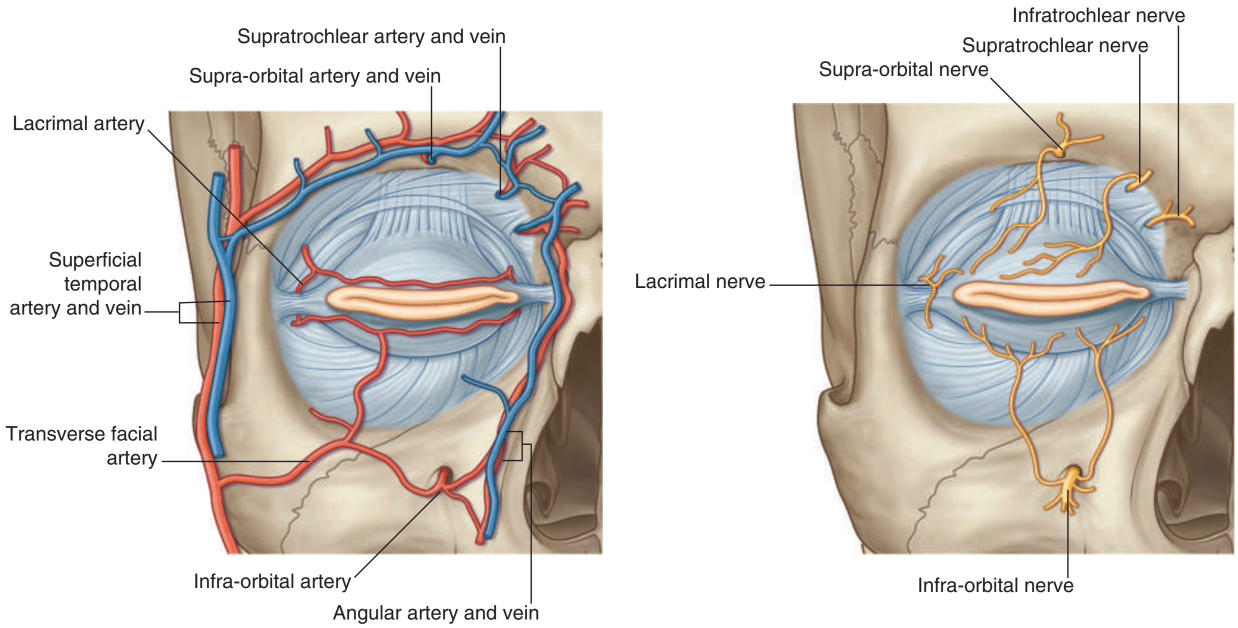

Supratrochlear artery and vein
Supra-orbital artery and vein
Lacrimal artery
Superficial temporal artery and vein
Transverse facial artery
Infra-orbital artery
Angular artery and vein
Infratrochlear nerve
Supratrochlear nerve
Supra-orbital nerve
Lacrimal nerve
Infra-orbital nerve

Plate 24.4 Anterior view of the lacrimal apparatus.

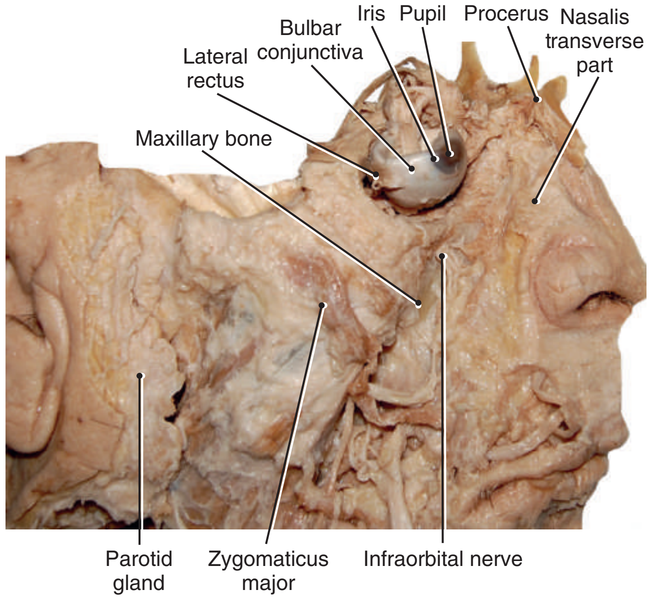

Iris
Pupil
Procerus
Nasalis transverse part
Bulbar conjunctiva
Lateral rectus
Maxillary bone
Parotid gland
Zygomaticus major
Infraorbital nerve

Fig. 24.27 Lateral craniotomy view of orbit with skin and subcutaneous tissue removed and osteotomy to zygomatic bone, revealing globe, musculature, and parotid gland.

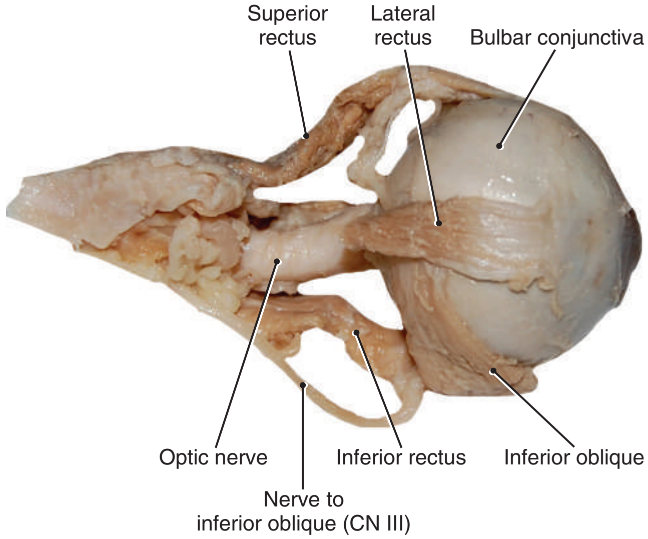

Superior rectus
Lateral rectus
Bulbar conjunctiva
Optic nerve
Inferior rectus
Inferior oblique
Nerve to inferior oblique (CN III)

Fig. 24.29 Superior view of globe with extraocular muscles removed from orbit.

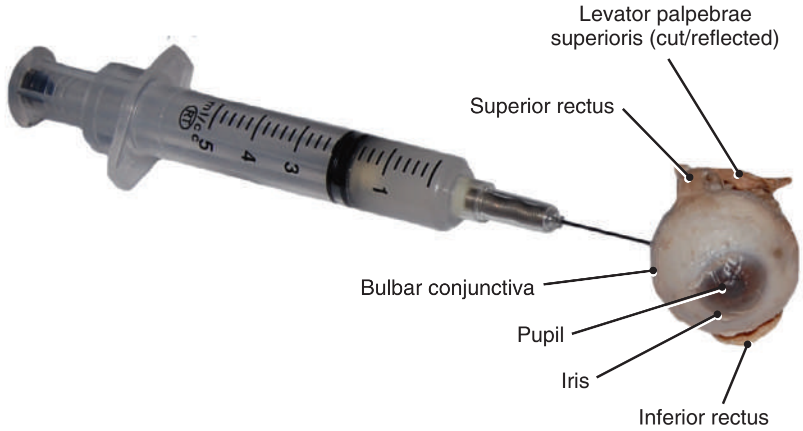

Levator palpebrae superioris (cut/reflected)
Superior rectus
Bulbar conjunctiva
Pupil
Iris
Inferior rectus

Fig. 24.28 Anterosuperior view of globe removed from orbit, with fluid injected to maintain morphologic shape.

- With a scalpel, cut the *optic nerve* and note the thick dura mater encircling it.
- At the middle of the cross section of the optic nerve, observe the small lumen that represents the central retinal artery (Fig. 24.30).
- Have a classmate hold the sclera firmly with their fingers (Fig. 24.31).
- Carefully incise the sclera with a scalpel (Fig. 24.32).
- On the hemisected orbit, identify the *limbus,* which is the junction of the cornea and the sclera (Fig. 24.33).
- The space between the iris and cornea is the anterior chamber. This is usually filled with the aqueous humor, but in the cadaver it will be empty (Fig. 24.34).

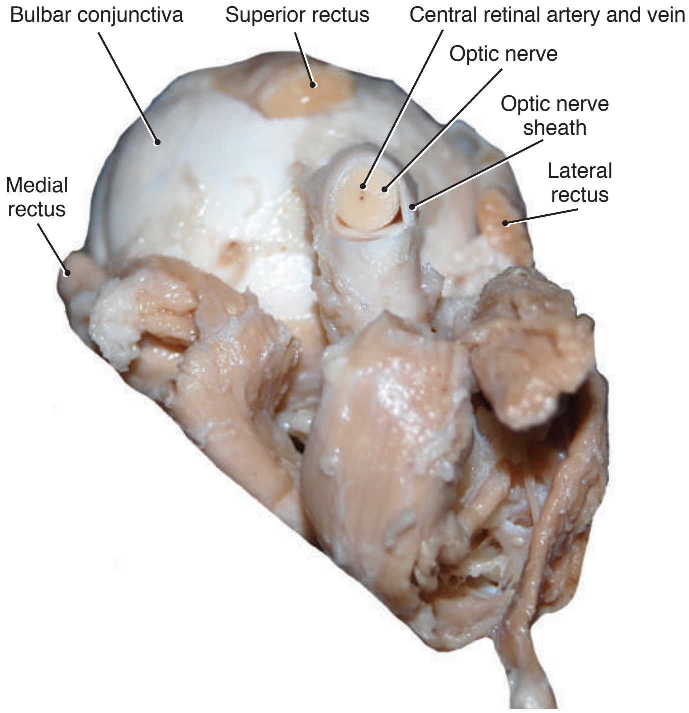

Bulbar conjunctiva
Superior rectus
Central retinal artery and vein
Optic nerve
Optic nerve sheath
Lateral rectus
Medial rectus

Fig. 24.30 Posterior view of globe with extraocular muscles removed from orbit.

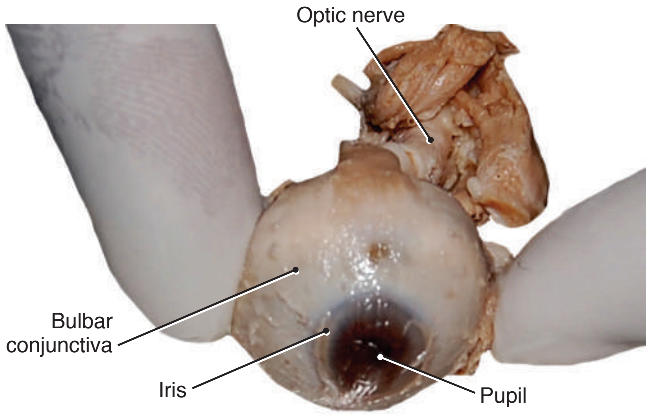

Optic nerve
Bulbar conjunctiva
Iris
Pupil

Fig. 24.31 Anterosuperior view of globe with extraocular muscles cut and reflected.

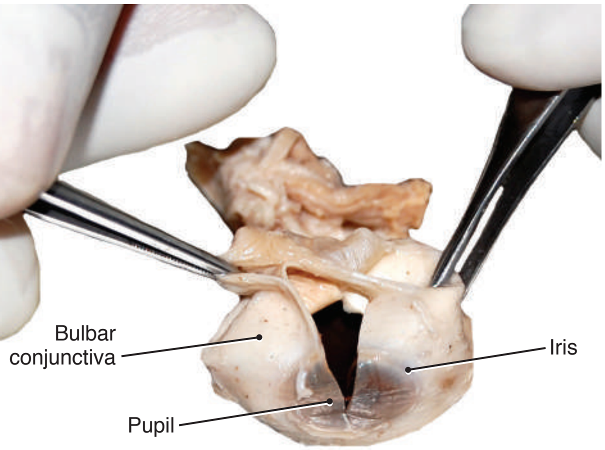

Bulbar conjunctiva
Iris
Pupil

Fig. 24.32 Anterosuperior view of globe removed from orbit.

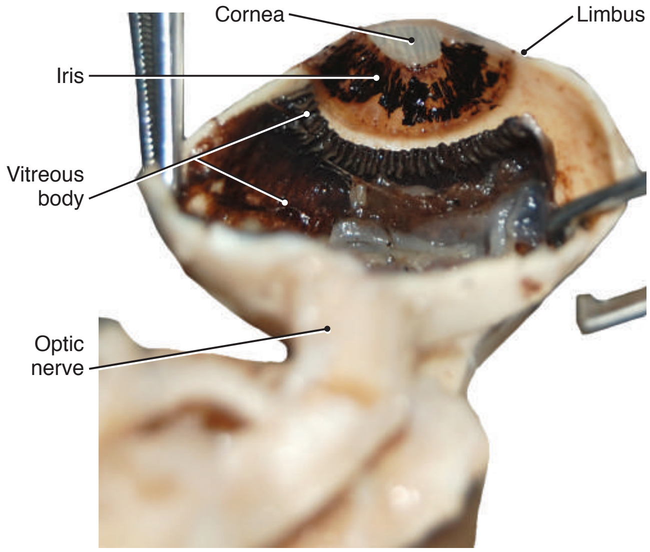

Cornea
Limbus
Iris
Vitreous body
Optic nerve

Fig. 24.33 Sagittal section of globe with vitreous humor removed.

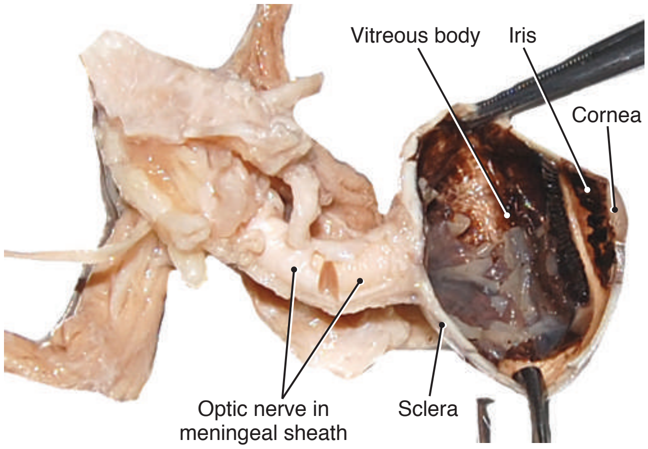

Vitreous body
Iris
Cornea
Optic nerve in meningeal sheath
Sclera

Fig. 24.34 Sagittal section of globe removed from orbit.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Trochlear
- ☐ Frontal
  - ☐ Supratrochlear
  - ☐ Supraorbital
- ☐ Lacrimal
- ☐ Nasociliary
  - ☐ Posterior ethmoidal (inconstant)
  - ☐ Anterior ethmoidal
  - ☐ Infratrochlear
  - ☐ Long ciliary
- ☐ Oculomotor
  - ☐ Superior division
  - ☐ Inferior division
- ☐ Abducens
- ☐ Optic
- ☐ Short ciliary nerves (8–10)
- ☐ Infraorbital nerve

GANGLION/FASCIA/FAT

- ☐ Ciliary ganglion
- ☐ Periorbita
- ☐ Periorbital fat
- ☐ Trochlea
- ☐ Anulus of Zinn

ARTERIES

- ☐ Ophthalmic
  - ☐ Anterior ethmoidal
  - ☐ Posterior ethmoidal
  - ☐ Central retinal
  - ☐ Lacrimal

VEINS

- ☐ Superior ophthalmic
- ☐ Inferior ophthalmic

MUSCLES

- ☐ Procerus

Recti

- ☐ Superior rectus
- ☐ Inferior rectus
- ☐ Medial rectus
- ☐ Lateral rectus

Obliques

- ☐ Superior oblique
- ☐ Inferior oblique
- ☐ Levator palpebrae superioris

BONES

- ☐ Frontal
- ☐ Lacrimal
- ☐ Maxilla
- ☐ Ethmoid
- ☐ Zygomatic

GLAND

- ☐ Lacrimal

SINUSES

- ☐ Frontal
- ☐ Ethmoidal
  - ☐ Anterior cells
  - ☐ Middle cells
  - ☐ Posterior cells

CHAPTER 25 EAR

ATLAS REFERENCES

Netter: 105–110
McMinn: 60–61
Gray's Atlas: 520–525

BEFORE YOU BEGIN

Identify the following bones in your atlas, text, and on a skull:

- Petrous part of temporal bone
- Squamous part of temporal bone
- Petrosquamous fissure (at junction of petrous and squamous parts)
- Arcuate eminence (overlies anterior semicircular canal)
- Internal acoustic meatus
- Hiatus of facial canal (greater petrosal nerve exits temporal bone from here)
- Groove for superior petrosal sinus
- Tegmen tympani (roof of middle ear between petrosquamous fissure and hiatus of facial canal)
- Jugular foramen
- Tympanic part of temporal bone (provides much of bony wall of external auditory meatus)
- Mandibular fossa
- Petrotympanic fissure (for passage of chorda tympani)
- Styloid process and stylomastoid foramen

External Ear

The ear is subdivided into the external, the middle, and the internal ear.

On the external ear of a classmate, identify the following structures (Fig. 25.1):

- Helix
- Antihelix and crura of antihelix
- Triangular fossa
- Concha
- Lobule
- Tragus
- Antitragus
- Intertragic notch
- External acoustic meatus

OPTIONAL DISSECTION (MIDDLE EAR)

○ **Students in most anatomy courses do not dissect the ear because it is a time-consuming dissection. This chapter presents a new, time-efficient method for exposing the structures of the middle ear.**
○ **If time permits, create a skin flap from the helix to expose part of the elastic fibrocartilage.**

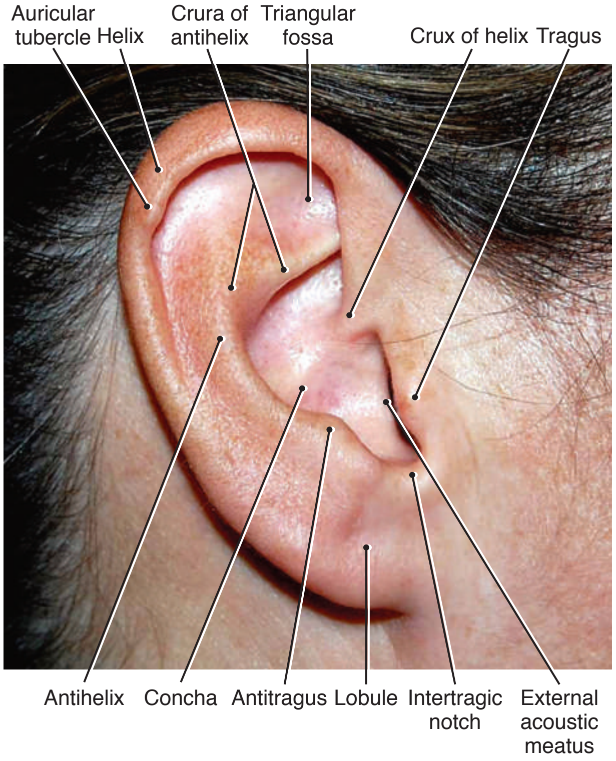


Fig. 25.1 External view of external ear with several surface features.

○ **Create a second skin flap at the lobule and note the dense, fibrous connective tissue.**
○ **With your scalpel, make an incision posterior to the auricle toward the neck.**
○ **Dissect away most of the soft tissue and the external acoustic meatus (Fig. 25.2).**
○ **Remove any debris present in the remaining part of the external meatus.**

DISSECTION **TIP**

With the aid of an otoscope, attempt to inspect the tympanic membrane. Remove any wax (cerumen) that may obstruct your view.

○ **Draw a line along the bony roof of the middle ear, the *tegmen tympani,* demarcating the length of the canal from the external acoustic meatus to the tympanic membrane.**
○ **Draw two dashed lines at the outer borders of the meatus (Fig. 25.3).**

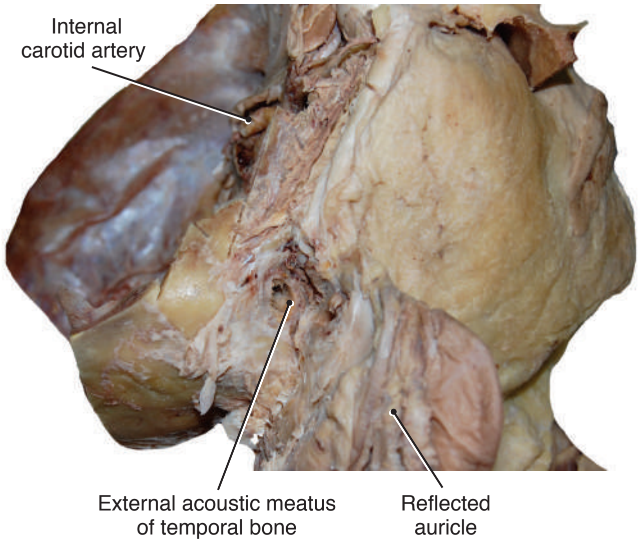

Internal carotid artery
External acoustic meatus of temporal bone
Reflected auricle

Fig. 25.2 Postcraniotomy horizontal section reveals lateral view of middle cranial fossa with external ear reflected, highlighting the external acoustic meatus of temporal bone.

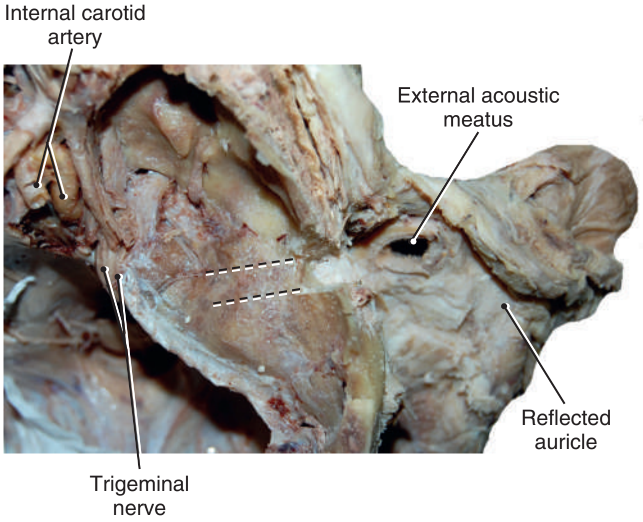

Internal carotid artery
External acoustic meatus
Reflected auricle
Trigeminal nerve

Fig. 25.3 Horizontal section after craniotomy shows middle cranial fossa with external ear reflected, highlighting the external acoustic meatus, trigeminal nerve, and internal carotid artery. *Dashed lines* demarcate lateral borders of the external acoustic meatus on tegmen tympani (roof of middle ear).

- With a chisel and a mallet, remove a small piece of bone, and expose the outer portion of the canal for inspection (Fig. 25.4).
- With a cotton swab or forceps, clean the acoustic meatus of debris and cerumen (Fig. 25.5).

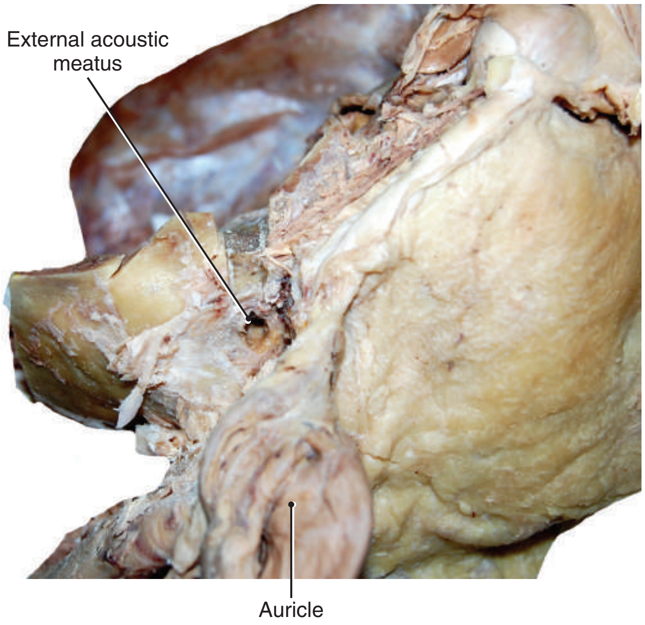

External acoustic meatus
Auricle

Fig. 25.4 Postcraniotomy horizontal section reveals lateral view of middle cranial fossa with external ear reflected.

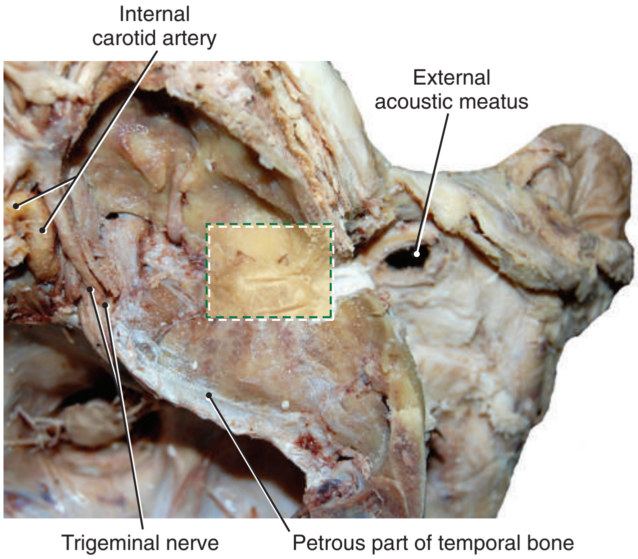

Internal carotid artery
External acoustic meatus
Trigeminal nerve
Petrous part of temporal bone

Fig. 25.5 Horizontal section after craniotomy reveals middle cranial fossa with external ear reflected; highlighted on tegmen tympani, *chisel marks* and *square* in center indicate lateral borders of external acoustic meatus.

DISSECTION TIP

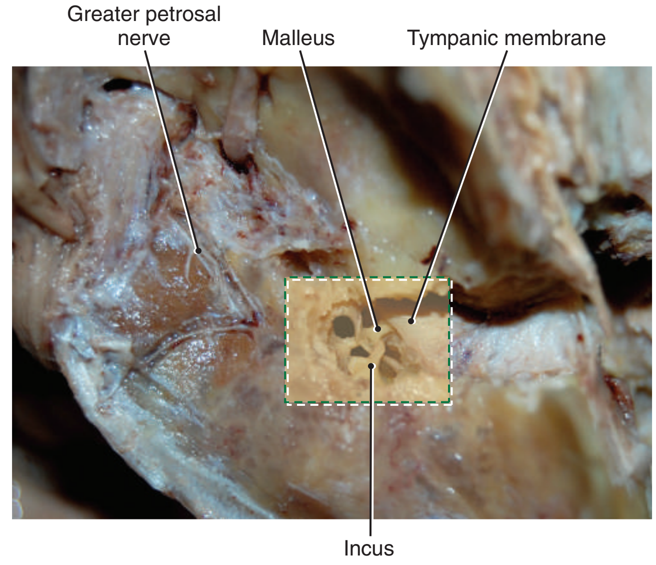
Do not place the swab or forceps too deeply into the canal, to prevent damage to the tympanic membrane.

- Continue the removal of bone with the chisel and the mallet on the surface of the tegmen tympani (see Fig. 25.5). The external acoustic meatus is about 3 to 4 cm long. Once the tegmen tympani is removed to the epitympanic recess (area superior to tympanic membrane) and using bone rongeurs, remove small pieces of bone and expose the tympanic membrane and the three auditory ossicles – malleus, incus, and stapes (Fig. 25.6 and Plate 25.1).

DISSECTION **TIP**

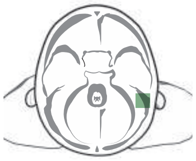
When exposing the tegmen tympani to reveal malleus, incus, and stapes, grasp the outer part of the tympanic membrane and pull it gently upward to maintain the position of the ossicles.

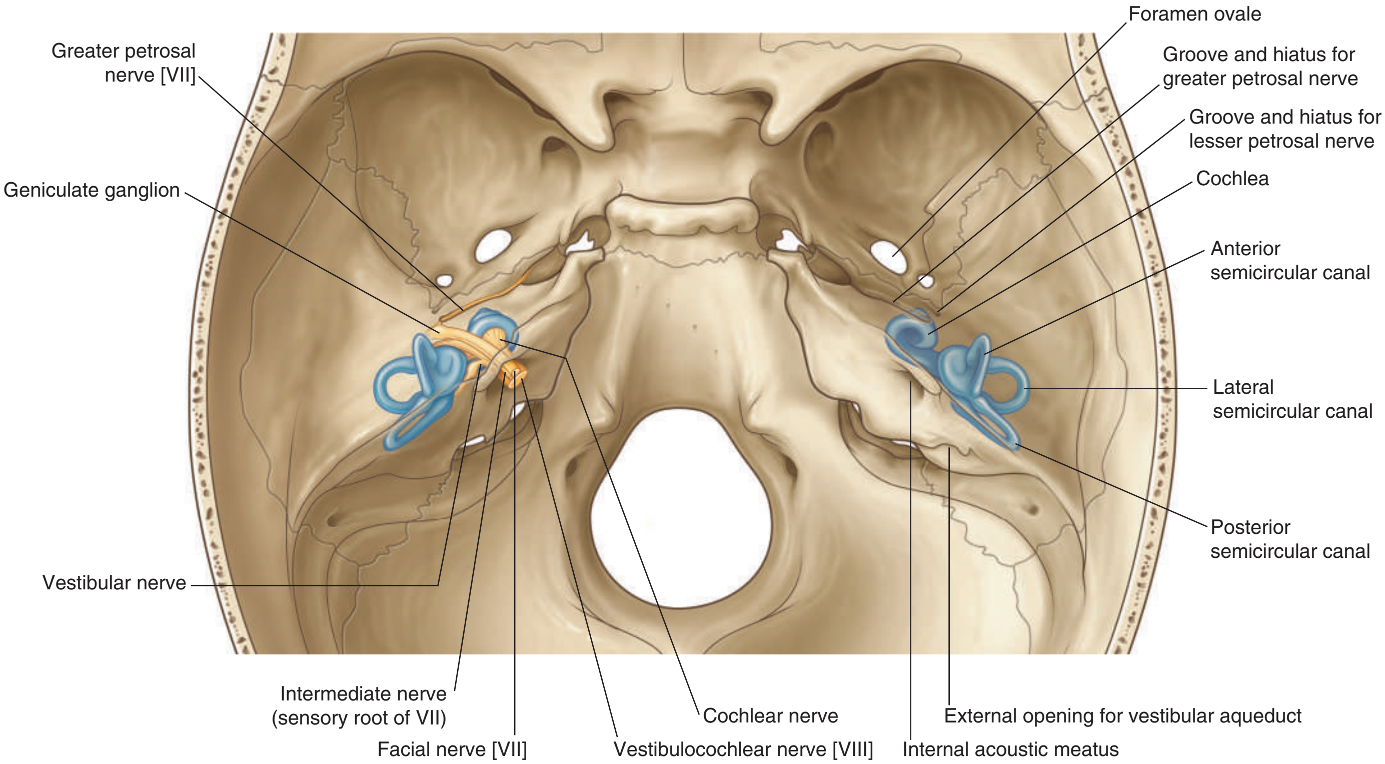
- At the final stage of dissection, cut the connective tissue layer covering the meatus, and appreciate the orientation of the tympanic membrane (see Fig. 25.6).
- The membrane is positioned obliquely in spaces in the external acoustic meatus at an angle of about 55 degrees (Fig. 25.7).



Greater petrosal nerve
Malleus
Tympanic membrane
Incus

Fig. 25.6 Tegmen tympani over the middle ear is removed, exposing tympanic membrane and two ear ossicles.





Greater petrosal nerve [VII]
Geniculate ganglion
Vestibular nerve
Intermediate nerve (sensory root of VII)
Facial nerve [VII]
Vestibulocochlear nerve [VIII]
Cochlear nerve
Internal acoustic meatus
External opening for vestibular aqueduct
Foramen ovale
Groove and hiatus for greater petrosal nerve
Groove and hiatus for lesser petrosal nerve
Cochlea
Anterior semicircular canal
Lateral semicircular canal
Posterior semicircular canal

Plate 25.1 Superior projection of internal ear in the temporal bone.

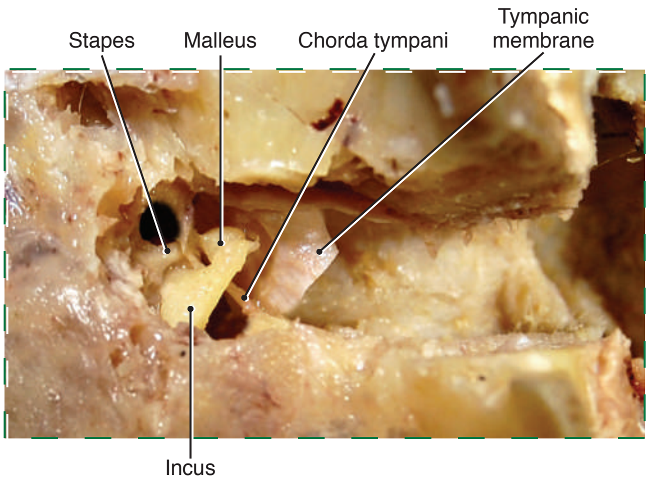


Fig. 25.7 Magnified view of middle cranial fossa with acoustic meatus and middle ear exposed, revealing tympanic membrane, ossicles (malleus, incus, stapes), and chorda tympani.

- Note the following relationships:
  - Stapedius muscle inserting onto the stapes.
  - Tendon of the tensor tympani muscle inserting onto the malleus.
  - Malleus attached to the tympanic membrane.

DISSECTION **TIP**

Dissecting the internal ear cavity is time-consuming; more importantly, however, inspection requires a dissecting microscope to identify auricular structures clearly.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Trigeminal
  - ☐ Mandibular (V3)
- ☐ Nervus intermedius
- ☐ Greater petrosal
- ☐ Facial
- ☐ Chorda tympani
- ☐ Vestibulocochlear
- ☐ Vagus

GANGLIA

- ☐ Trigeminal
- ☐ Geniculate

ARTERY

- ☐ Internal carotid

MUSCLES

- ☐ Tensor tympani
- ☐ Stapedius
- ☐ Auricularis

BONES

- ☐ Petrous part of temporal bone
- ☐ Tegmen tympani (roof)
- ☐ Auditory ossicles
  - ☐ Malleus
  - ☐ Incus
  - ☐ Stapes

OTHER STRUCTURES

- ☐ External acoustic meatus
- ☐ Tympanic membrane
- ☐ Oval window

CARTILAGE

- ☐ Helix
- ☐ Antihelix
- ☐ Tragus
- ☐ Antitragus
- ☐ Auricular tubercle (of Darwin)

CHAPTER 26 NASAL CAVITY

ATLAS REFERENCES

Netter: 45–52, 61, 142
McMinn: 58, 59, 73
Gray's Atlas: 566–571

DISSECTION STEPS

- Exposure of the contents of the nasal cavity requires a midsagittal transection through the head (Fig. 26.1).

DISSECTION **TIP**

Electric saws are usually too small for transection of the head. Make sure that one of your classmates holds the cadaver head firmly as you cut with the saw.

- Place the saw as close as possible to the midline. Begin the cut externally from the face toward the midportion of the head (Fig. 26.2).
- Split the head in half, and choose one of the two halves to decapitate (Figs. 26.3 and 26.4).
- Clean away soft tissues or any bony fragments after the hemisection (compare Fig. 26.4 with Fig. 26.5).

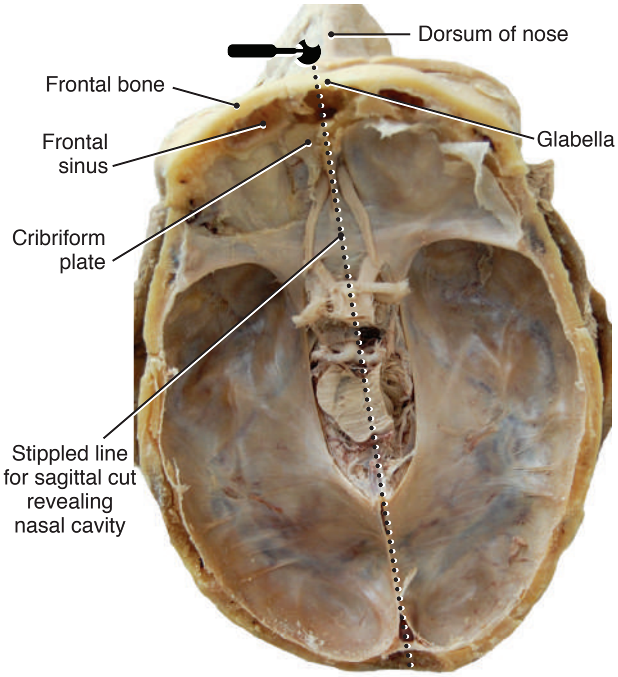

Dorsum of nose
Frontal bone
Glabella
Frontal sinus
Cribriform plate
Stippled line for sagittal cut revealing nasal cavity

Fig. 26.1 Craniotomy view with *dashed line* for sagittal section.

- Identify several landmarks as indicated on the dissection photographs of the hemisected head.
- The nasal cavities extend from the nares anteriorly to the choanae posteriorly, constituting the *nasal cavity proper.* Identify the superior, middle, and inferior nasal

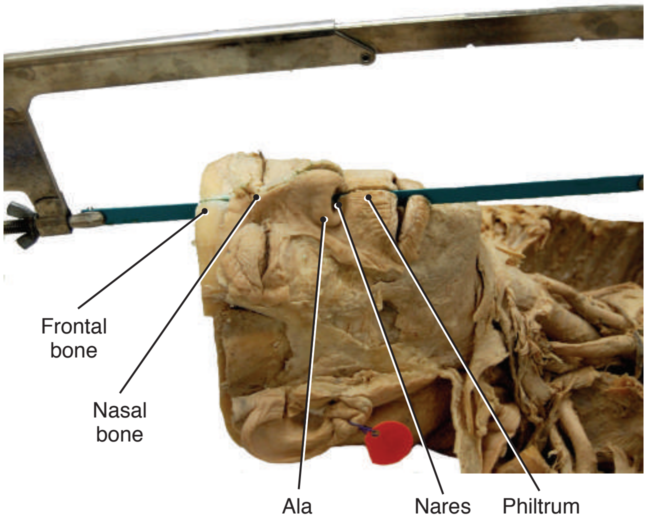

Frontal bone
Nasal bone
Ala
Nares
Philtrum

Fig. 26.2 Anterolateral view of face with previous craniotomy, demonstrating sagittal cut of nasal cavity.

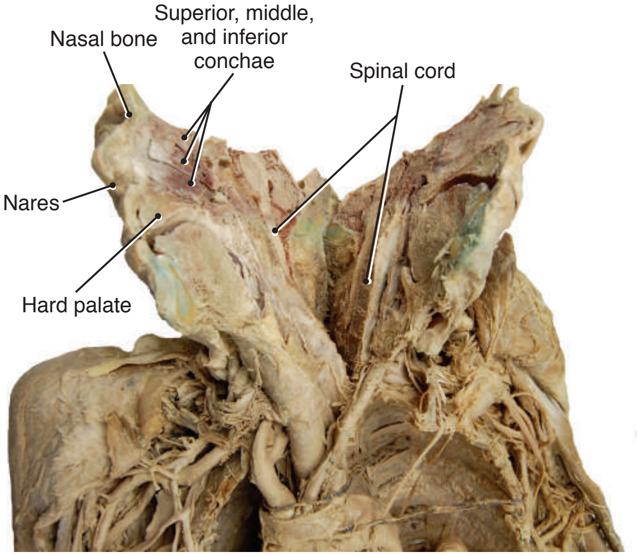
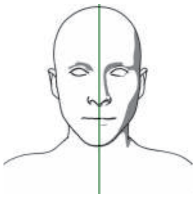

Nasal bone
Superior, middle, and inferior conchae
Spinal cord
Nares
Hard palate

Fig. 26.3 Anterior view of sagittal cut of nasal and oral cavities revealing nasal septum with left and concha on right.



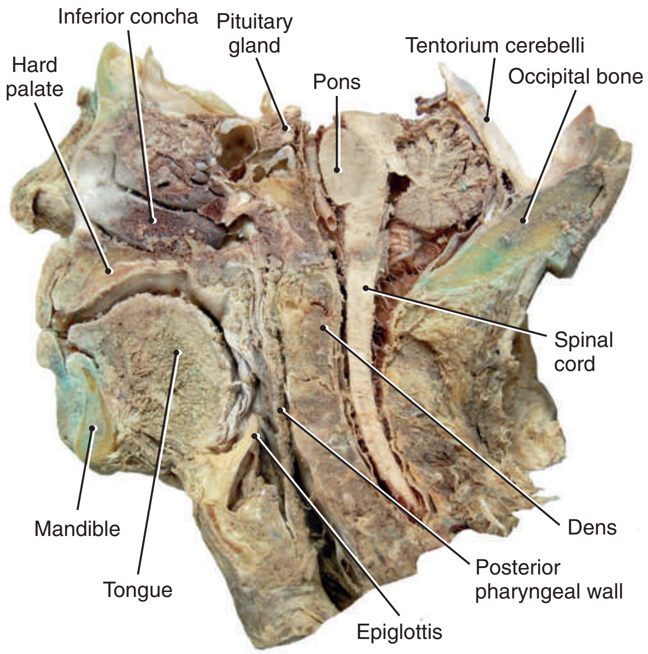

Inferior concha
Pituitary gland
Hard palate
Tentorium cerebelli
Pons
Occipital bone
Spinal cord
Mandible
Dens
Tongue
Posterior pharyngeal wall
Epiglottis

Fig. 26.4 Sagittal view of nasal and oral cavities revealing nasal bone, cartilage, concha, and openings. Structures of mouth and pharynx include hard palate, soft palate, tongue, mandible, epiglottis, and posterior pharyngeal wall.

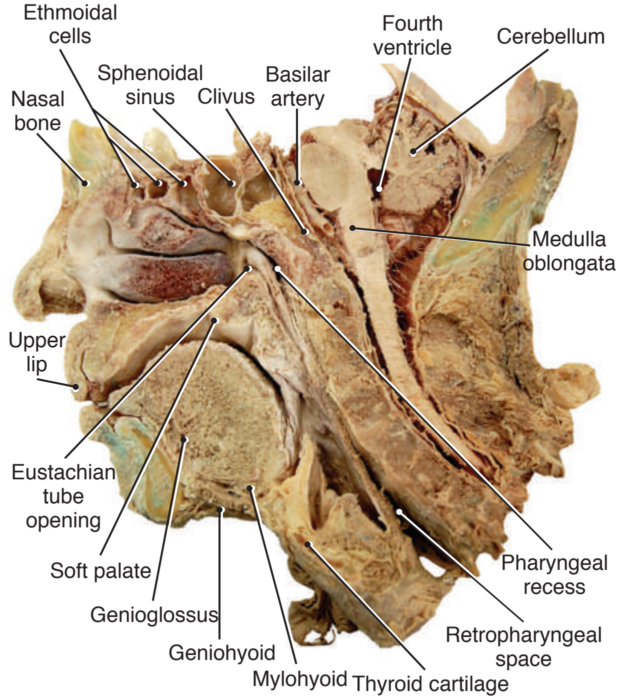

Ethmoidal cells
Fourth ventricle
Cerebellum
Sphenoidal sinus
Basilar artery
Nasal bone
Clivus
Medulla oblongata
Upper lip
Eustachian tube opening
Soft palate
Pharyngeal recess
Genioglossus
Retropharyngeal space
Geniohyoid
Mylohyoid
Thyroid cartilage

Fig. 26.5 Sagittal view of nasal and oral regions. Nasal region structures include sphenoidal sinus, ethmoidal sinus (anterior, middle, and posterior cells), nasal concha, and eustachian tube opening. Oral structures include lips, hard and soft palate, tongue, oral floor muscles (genioglossus, geniohyoid, mylohyoid), epiglottis, pharyngeal recess, and retropharyngeal space.

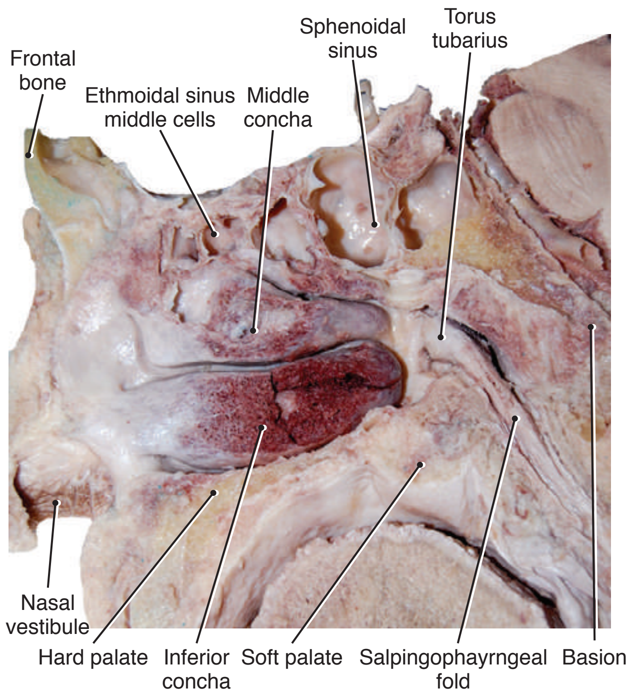

Sphenoidal sinus
Torus tubarius
Frontal bone
Ethmoidal sinus middle cells
Middle concha
Nasal vestibule
Hard palate
Inferior concha
Soft palate
Salpingophayrngeal fold
Basion

Fig. 26.6 Sagittal view of nasal cavity revealing sphenoidal, ethmoidal, and frontal sinuses; concha; nasal bone; torus tubarius; and salpingopharyngeal fold.

conchae, which are located within the nasal cavity proper (Figs. 26.6 and 26.7).

- ○ Identify the *superior meatus,* the space between the superior and middle conchae.
- ○ Continue inferiorly and identify the space between the middle and inferior conchae, the *middle meatus.*
- ○ Finally, identify the space between the inferior concha and the hard palate, the *inferior meatus* (see Figs. 26.6 and 26.7).
- ○ Posterior to the superior concha is a space referred to as the *sphenoethmoidal recess.* Identify the opening for the sphenoidal sinus into this recess (see Figs. 26.6 and 26.7).

DISSECTION TIP

Some specimens have an increased thickness of the nasal mucosa (see Figs. 26.6 and 26.7).

DISSECTION TIP

In most cadavers it is necessary to break away part of the thin, medial wall of the sphenoidal sinus to gain access to its interior. Some specimens may also have a "supreme" concha.

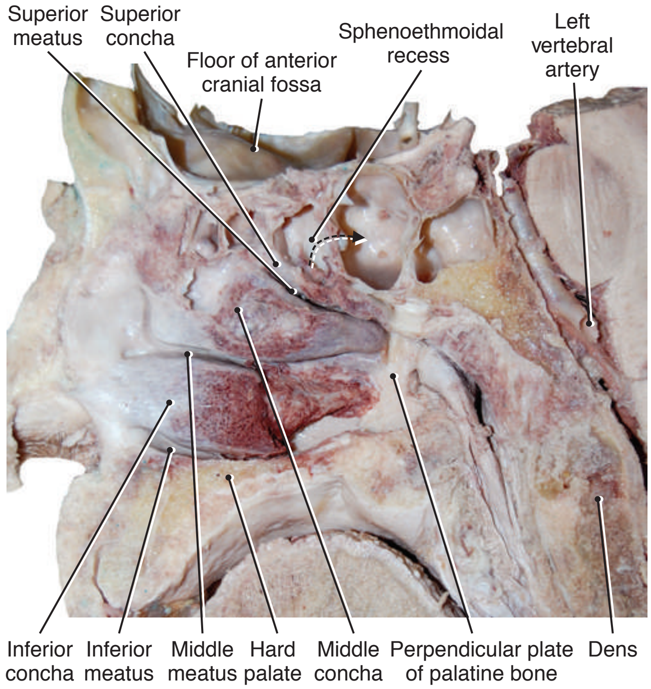

Superior meatus
Superior concha
Floor of anterior cranial fossa
Sphenoethmoidal recess
Left vertebral artery
Inferior concha
Inferior meatus
Middle meatus
Hard palate
Middle concha
Perpendicular plate of palatine bone
Dens

Fig. 26.7 Sagittal view of nasal cavity revealing sphenoidal and ethmoid sinuses and nasal concha highlighting drainage pathways that include sphenoethmoidal recess and meatus associated with superior, middle, and inferior conchae.

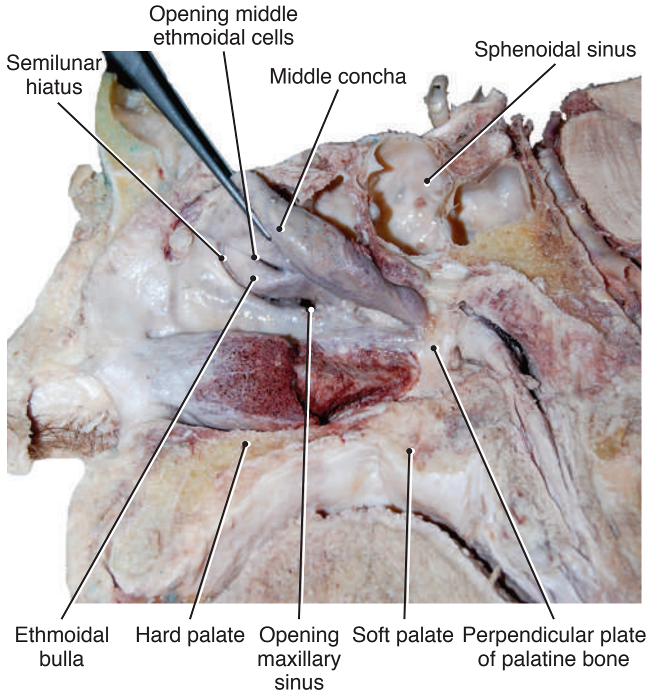

Semilunar hiatus
Opening middle ethmoidal cells
Middle concha
Sphenoidal sinus
Ethmoidal bulla
Hard palate
Opening maxillary sinus
Soft palate
Perpendicular plate of palatine bone

Fig. 26.8 Sagittal view of nasal cavity with middle concha reflected, revealing opening of ethmoidal cells, ethmoidal bulla, semilunar hiatus, and maxillary sinus opening.

- **With forceps, lift the middle meatus upward and identify the ethmoidal bulla.**

ANATOMY **NOTE**

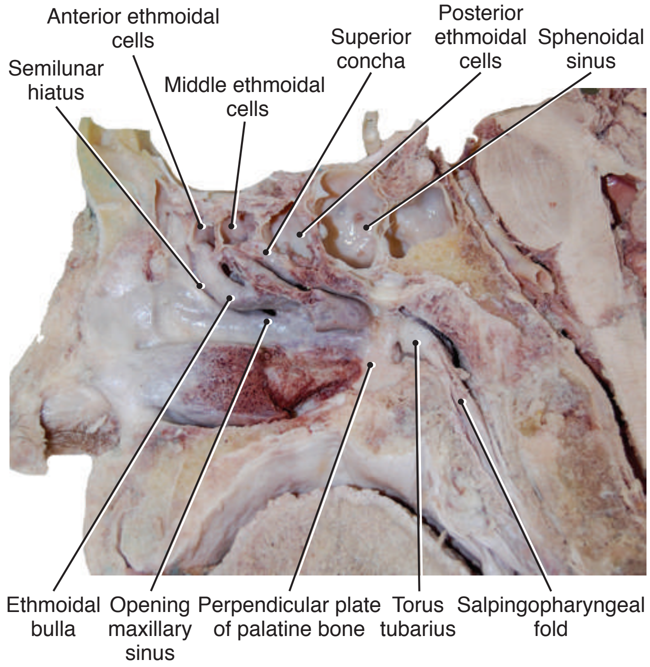
The ethmoidal bulla can be oversized from hypertrophy of the ethmoidal cells.

- **Locate the opening of the ethmoidal infundibulum into the semilunar hiatus (Fig. 26.8).**
- **With scissors or a scalpel, cut the middle concha away from its junction with the lateral wall of the nasal cavity, and completely expose the middle meatus (Fig. 26.9).**
- **Identify the anterior, middle, and posterior *ethmoidal cells*. In the superior meatus, find the ostia of the posterior ethmoidal cells (see Fig. 26.9 and Plate 26.1).**

ANATOMY **NOTE**

The *hiatus semilunaris* is the long, semicircular groove into which the frontonasal duct drains (drainage of frontal sinus through infundibulum), as well as the anterior ethmoidal cells.

- **Identify the opening of the maxillary sinus. Pass a probe into this opening.**


Anterior ethmoidal cells
Semilunar hiatus
Middle ethmoidal cells
Superior concha
Posterior ethmoidal cells
Sphenoidal sinus
Ethmoidal bulla
Opening maxillary sinus
Perpendicular plate of palatine bone
Torus tubarius
Salpingopharyngeal fold

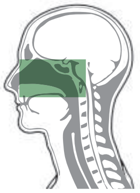


Fig. 26.9 Sagittal view of nasal cavity with superior concha cut and middle concha removed revealing sphenoidal sinus and posterior, middle, and anterior ethmoidal cells. Middle concha removed, highlighting ethmoidal bulla, semilunar hiatus, and maxillary sinus opening.

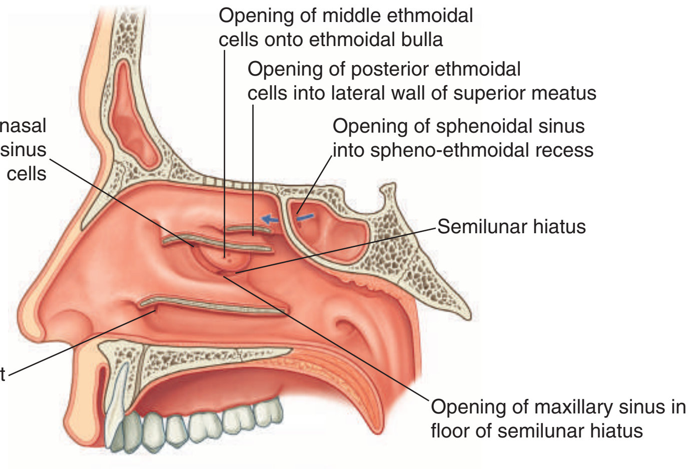

Opening of middle ethmoidal cells onto ethmoidal bulla
Opening of posterior ethmoidal cells into lateral wall of superior meatus
Infundibulum opening of frontonasal duct that drains the frontal sinus and anterior ethmoidal cells
Opening of sphenoidal sinus into spheno-ethmoidal recess
Semilunar hiatus
Opening of nasolacrimal duct
Opening of maxillary sinus in floor of semilunar hiatus

Plate 26.1 A lateral view of the structures of the nasal cavity, with conchae cut away.

DISSECTION TIP

Inspect the area of the middle meatus to determine whether there may be accessory openings for the maxillary sinus.

- The *ethmoidal bulla* is formed by the bulging of ethmoidal cells into the middle meatus (see Fig. 26.9).
- Remove the anterior half of the inferior nasal concha and identify the opening of the nasolacrimal duct (Fig. 26.10).
- Place a probe in the nasolacrimal duct.
- Before dissection of the pterygopalatine fossa, identify the opening to the auditory or pharyngotympanic tube *(eustachian tube)* and place a probe into it (see Fig. 26.10).
- Identify the elevation of the auditory tube and its muscular ridge, the *salpingopharyngeal fold*. At the opening of the eustachian tube, dissect away the mucous membrane (Fig. 26.11).
- Identify the *levator* veli palatini muscle (Fig. 26.12).
- Anterior to the levator veli palatini, dissect out fat and other connective tissues (Fig. 26.13).
- Identify the *tensor* veli palatini muscle (see Fig. 26.13).

DISSECTION TIP

The tensor veli palatini and levator veli palatini muscles are easy to distinguish because of the white, *tendinous* fibers of the *tensor* veli palatini (see Fig. 26.13).

- Lift the soft tissues and mucous membranes at the space posterior to the nasal conchae and the tensor veli palatini (in essence, the posterior plate of the pterygoid process of the sphenoid bone) (Fig. 26.14).
- Cut the posterior one third of the middle and superior conchae, and remove the mucosa and soft tissues to expose the palatine bone (Fig. 26.15).

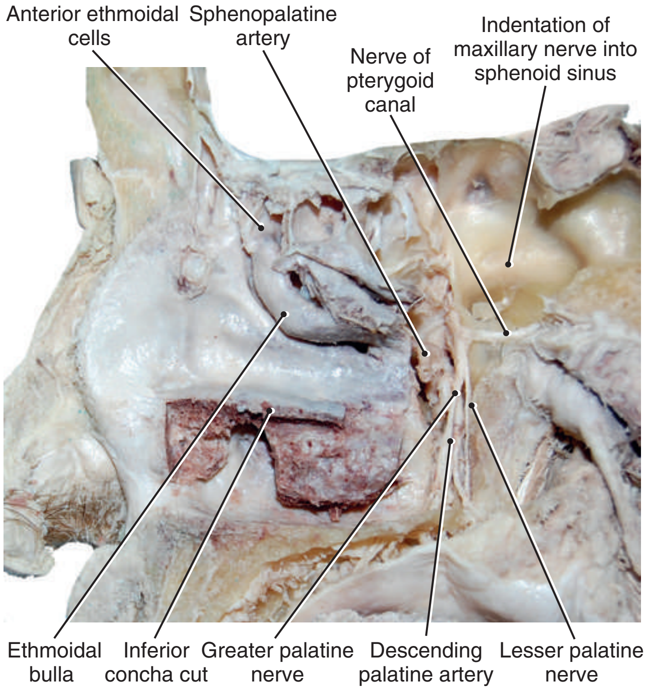

Anterior ethmoidal cells
Sphenopalatine artery
Nerve of pterygoid canal
Indentation of maxillary nerve into sphenoid sinus
Ethmoidal bulla
Inferior concha cut
Greater palatine nerve
Descending palatine artery
Lesser palatine nerve

Fig. 26.10 Sagittal view of nasal cavity with middle concha removed and inferior concha cut and partially removed, revealing drainage pathways of superior, middle, and inferior conchae (nasolacrimal duct) and osteotomy to pterygopalatine fossa. Pterygopalatine fossa includes ganglion, nerve of pterygoid canal, greater and lesser palatine nerves, and sphenopalatine and descending palatine arteries.

DISSECTION TIP

The palatine bone is thin, and you can identify the course of the greater and lesser palatine nerves and vessels before removing it.

- With a small electric drill, cut away the palatine bone, making a vertical cut from the sphenoidal sinus to

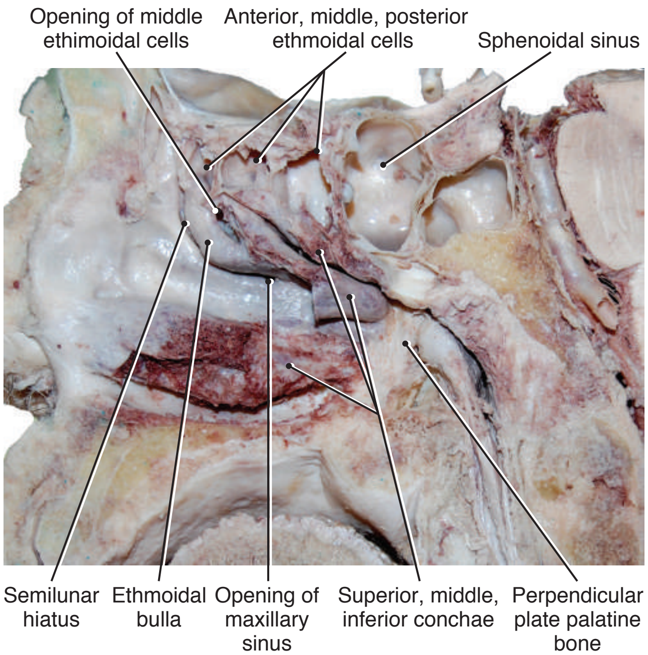
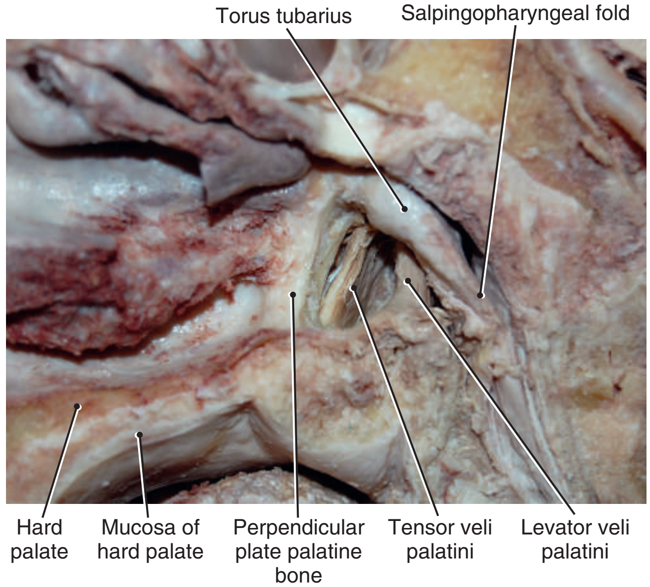

Opening of middle ethimoidal cells
Anterior, middle, posterior ethmoidal cells
Sphenoidal sinus
Semilunar hiatus
Ethmoidal bulla
Opening of maxillary sinus
Superior, middle, inferior conchae
Perpendicular plate palatine bone

Fig. 26.11 Sagittal view of nasal cavity revealing sphenoidal, posterior middle, and anterior ethmoidal cells. Middle concha removed, revealing semilunar hiatus, ethmoid bulla, maxillary sinus opening, and superior, middle, and inferior conchae, as well as the perpendicular plate of palatine bone.


Torus tubarius
Salpingopharyngeal fold
Hard palate
Mucosa of hard palate
Perpendicular plate palatine bone
Tensor veli palatini
Levator veli palatini

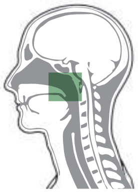
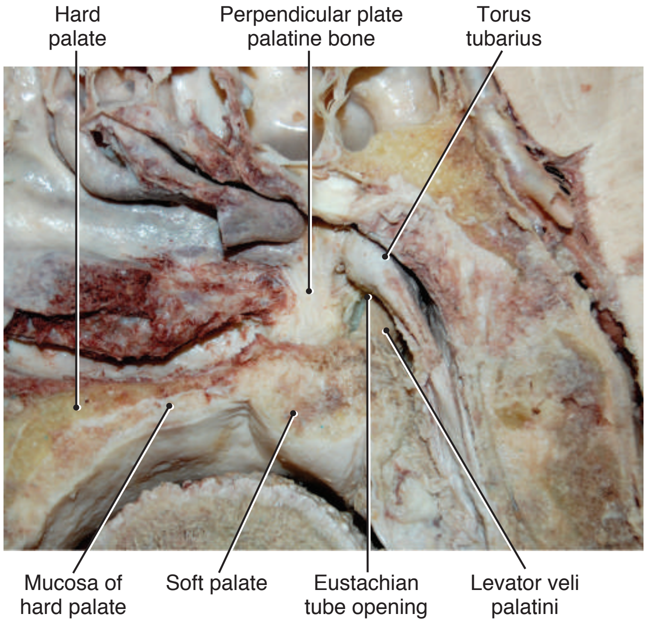


Fig. 26.13 Sagittal view of nasal cavity highlighting hard palate and revealing tensor and levator veli palatini muscles, torus tubarius, and salpingopharyngeal fold.


Hard palate
Perpendicular plate palatine bone
Torus tubarius
Mucosa of hard palate
Soft palate
Eustachian tube opening
Levator veli palatini

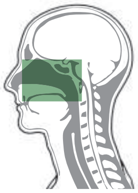
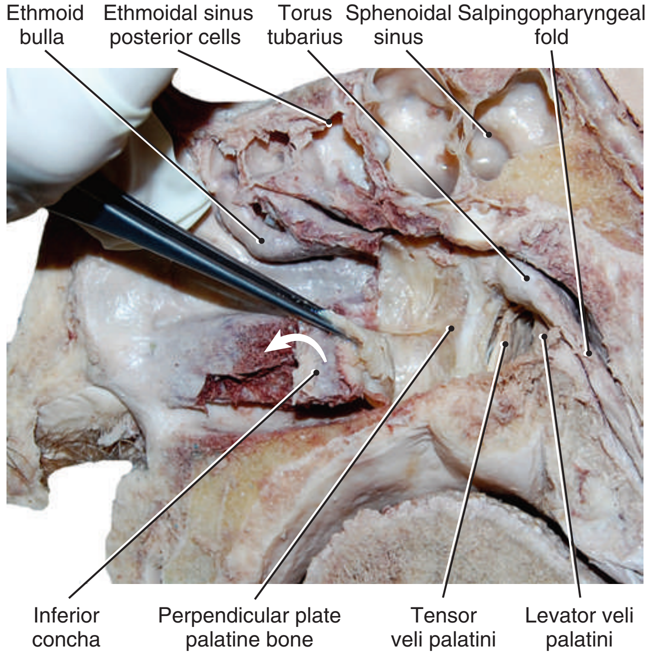


Fig. 26.12 Sagittal view of nasal cavity revealing hard and soft palate, torus tubarius, salpingopharyngeal fold, opening of eustachian tube, and levator veli palatini muscle.


Ethmoid bulla
Ethmoidal sinus posterior cells
Torus tubarius
Sphenoidal sinus
Salpingopharyngeal fold
Inferior concha
Perpendicular plate palatine bone
Tensor veli palatini
Levator veli palatini

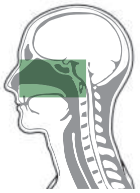


Fig. 26.14 Sagittal view of nasal cavity with superior, middle, and inferior concha cut, revealing perpendicular plate of palatine bone, tensor and levator veli palatini, torus tubarius, and salpingopharyngeal fold.

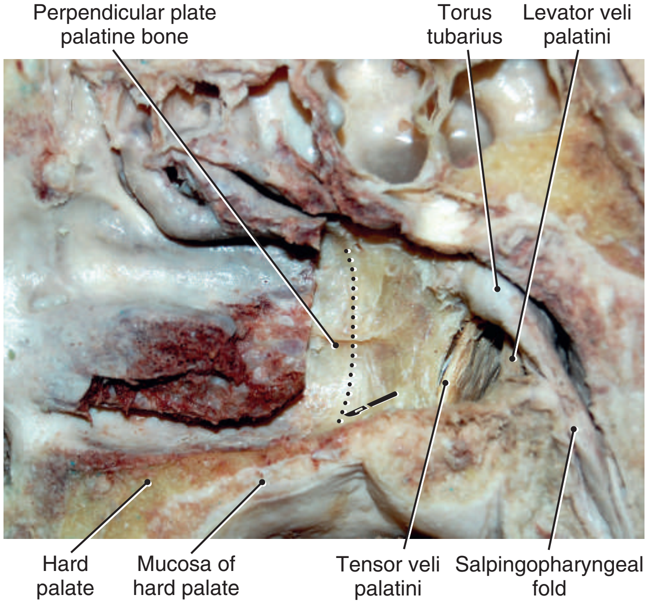
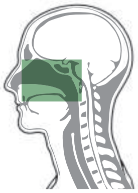

Perpendicular plate palatine bone
Torus tubarius
Levator veli palatini
Hard palate
Mucosa of hard palate
Tensor veli palatini
Salpingopharyngeal fold

Fig. 26.15 Sagittal view of nasal cavity highlighting perpendicular plate of palatine bone, tensor and levator veli palatini muscles, torus tubarius, and mucosa of hard palate.



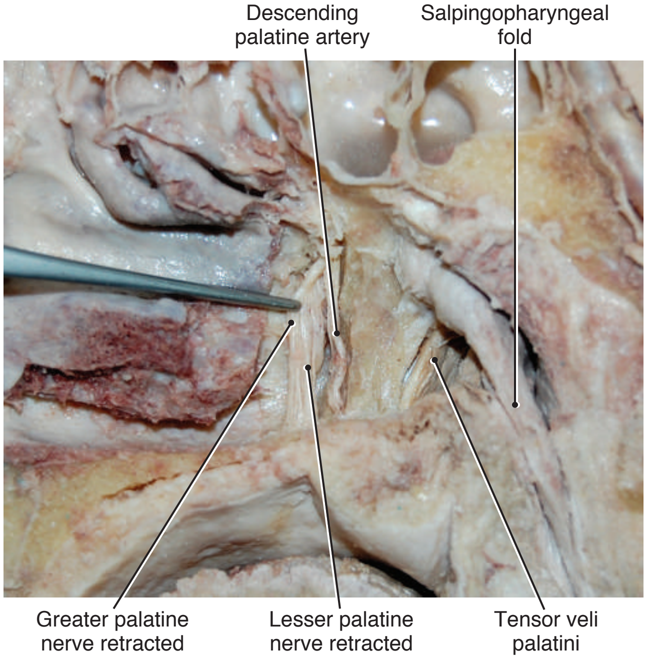
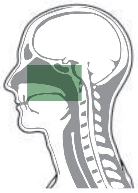

Descending palatine artery
Salpingopharyngeal fold
Greater palatine nerve retracted
Lesser palatine nerve retracted
Tensor veli palatini

Fig. 26.17 Sagittal view of nasal cavity with greater and lesser palatine nerves retracted, revealing descending palatine artery.



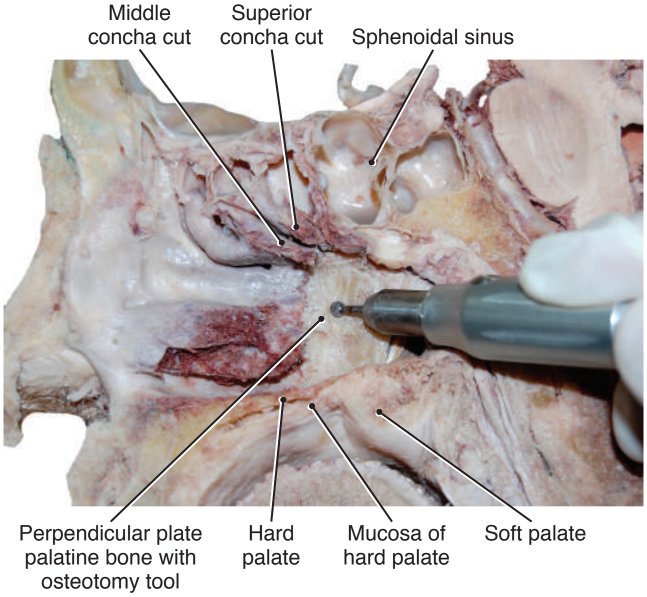

Middle concha cut
Superior concha cut
Sphenoidal sinus
Perpendicular plate palatine bone with osteotomy tool
Hard palate
Mucosa of hard palate
Soft palate

Fig. 26.16 Sagittal view of nasal cavity highlighting middle and superior conchae cut and perpendicular plate of palatine bone with small osteotomy to reveal pterygopalatine fossa structures.

the hard palate and posteriorly to the middle concha (see Figs. 26.15 and 26.16).

- First, expose the greater and lesser palatine nerves, as well as the descending palatine artery and the greater and lesser palatine arteries (Figs. 26.17 and 26.18).
- Continue drilling upward to the sphenoidal sinus. Identify the sphenopalatine artery and the pterygopalatine ganglion (Fig. 26.19 and Plate 26.2).

DISSECTION TIP

In this part of dissection, use fine forceps and scissors to separate the delicate nerves and arteries.

- Continue drilling posteriorly to the pterygopalatine ganglion and inferior to the sphenoidal sinus. Expose the *vidian nerve* (nerve to pterygoid canal) (Fig. 26.20).

ANATOMY NOTE

The greater and deep petrosal nerves unite and form the nerve of the pterygoid canal. This nerve passes through the pterygoid canal of the sphenoid bone and then into the pterygopalatine fossa.

- If time permits, drill away the sphenoidal sinus, and expose the connection of the pterygopalatine ganglion with the maxillary nerve (Fig. 26.21).
- With scissors, reflect the oral mucosa from the hard palate, and identify the distribution of the greater and lesser palatine nerves (Fig. 26.22).
- The lateral wall of the nasal cavity is dissected on one side of the head, as well as the pterygopalatine fossa. Dissect the nasal septum on the opposite side, i.e., the other hemisected part of the head (Fig. 26.23).

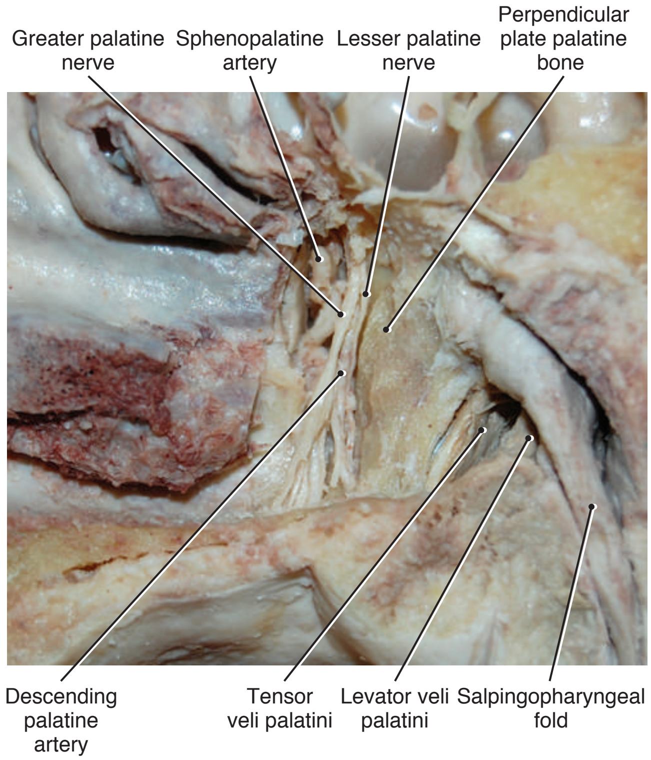
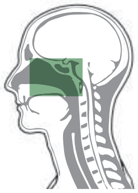

Greater palatine nerve
Sphenopalatine artery
Lesser palatine nerve
Perpendicular plate palatine bone
Descending palatine artery
Tensor veli palatini
Levator veli palatini
Salpingopharyngeal fold

Fig. 26.18 Sagittal view of nasal cavity highlighting osteotomy of perpendicular plate of palatine bone to reveal sphenopalatine artery, greater and lesser palatine nerves, and descending palatine artery.



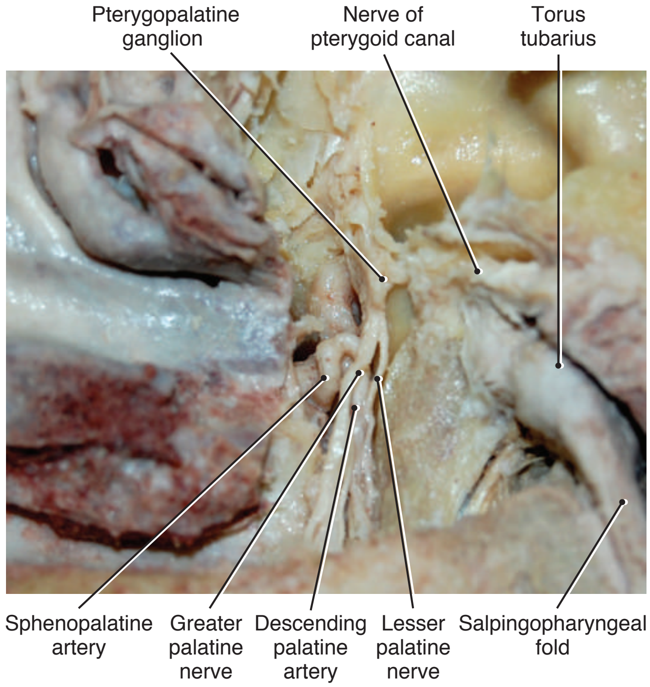
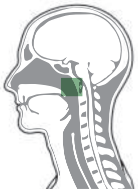

Pterygopalatine ganglion
Nerve of pterygoid canal
Torus tubarius
Sphenopalatine artery
Greater palatine nerve
Descending palatine artery
Lesser palatine nerve
Salpingopharyngeal fold

Fig. 26.19 Sagittal view of nasal cavity with osteotomy of perpendicular plate of palatine bone, revealing sphenopalatine artery, pterygopalatine ganglion, nerve of pterygoid canal, greater and lesser palatine nerves, and descending palatine artery.



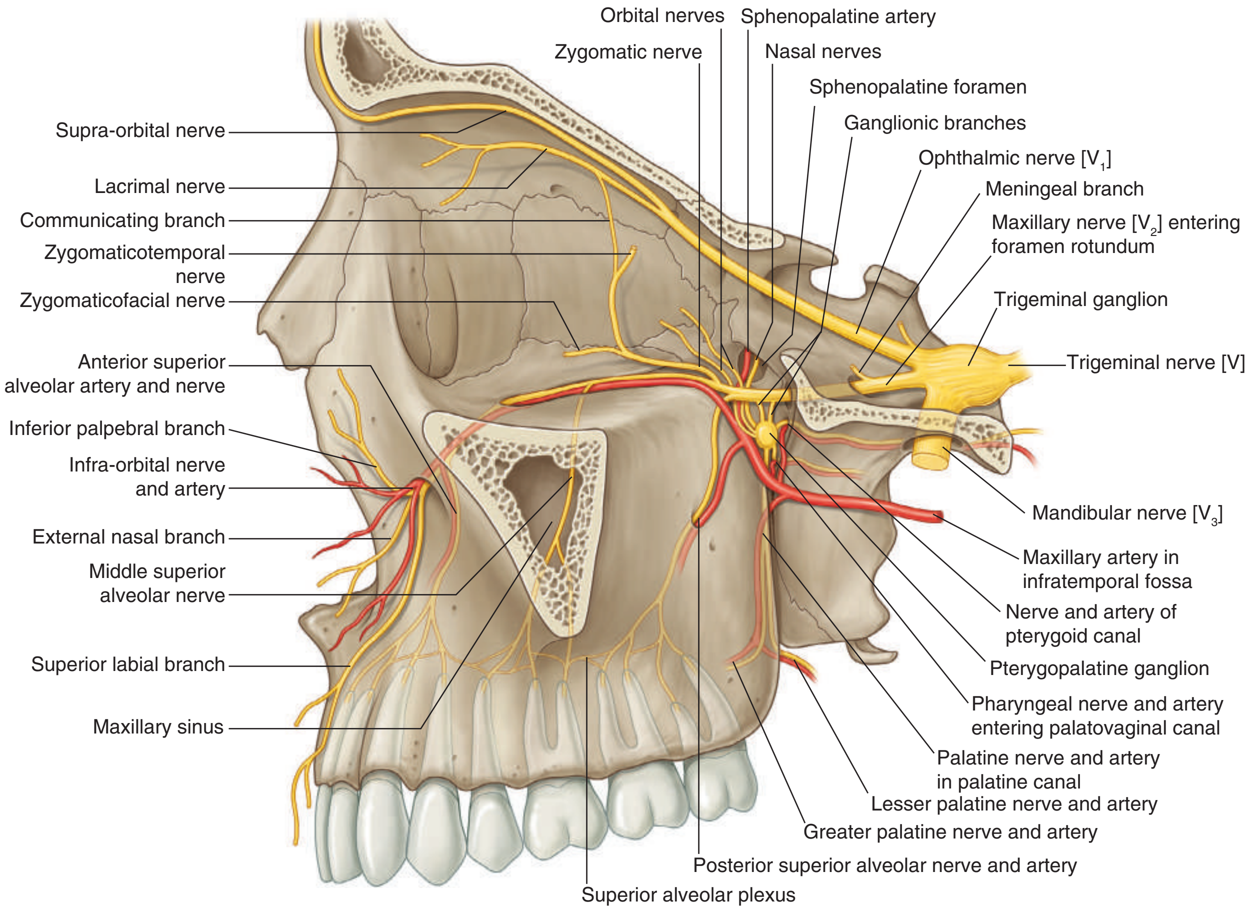

Orbital nerves
Sphenopalatine artery
Zygomatic nerve
Nasal nerves
Sphenopalatine foramen
Ganglionic branches
Ophthalmic nerve [V_1]
Meningeal branch
Maxillary nerve [V_2] entering foramen rotundum
Trigeminal ganglion
Trigeminal nerve [V]
Supra-orbital nerve
Lacrimal nerve
Communicating branch
Zygomaticotemporal nerve
Zygomaticofacial nerve
Anterior superior alveolar artery and nerve
Inferior palpebral branch
Infra-orbital nerve and artery
External nasal branch
Middle superior alveolar nerve
Superior labial branch
Maxillary sinus
Mandibular nerve [V_3]
Maxillary artery in infratemporal fossa
Nerve and artery of pterygoid canal
Pterygopalatine ganglion
Pharyngeal nerve and artery entering palatovaginal canal
Palatine nerve and artery in palatine canal
Lesser palatine nerve and artery
Greater palatine nerve and artery
Posterior superior alveolar nerve and artery
Superior alveolar plexus

Plate 26.2 Nerves and arteries of the pterygopalatine fossa.

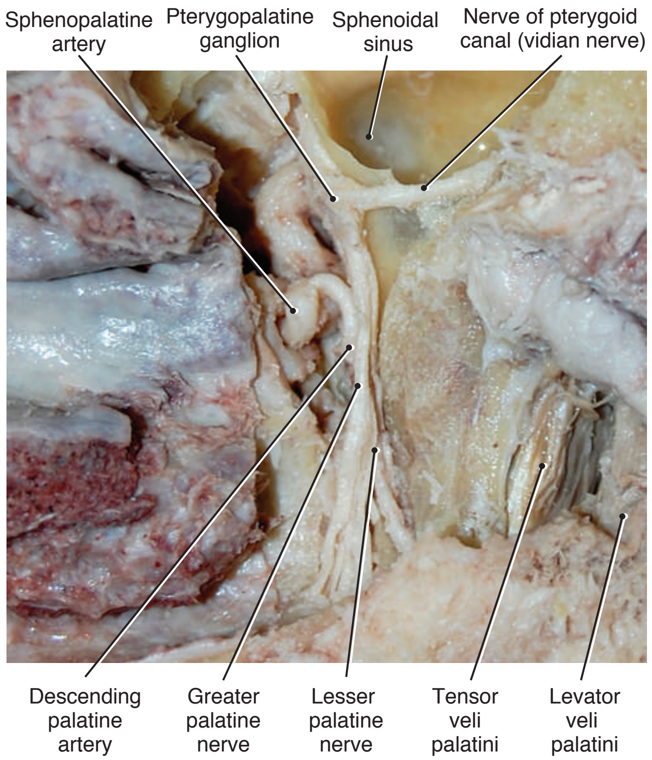
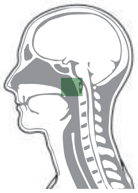

Sphenopalatine artery
Pterygopalatine ganglion
Sphenoidal sinus
Nerve of pterygoid canal (vidian nerve)
Descending palatine artery
Greater palatine nerve
Lesser palatine nerve
Tensor veli palatini
Levator veli palatini

Fig. 26.20 Sagittal view of nasal cavity with osteotomy of perpendicular plate of palatine bone, revealing pterygopalatine ganglion, nerve of pterygoid canal, greater and lesser palatine nerves, and descending palatine artery.



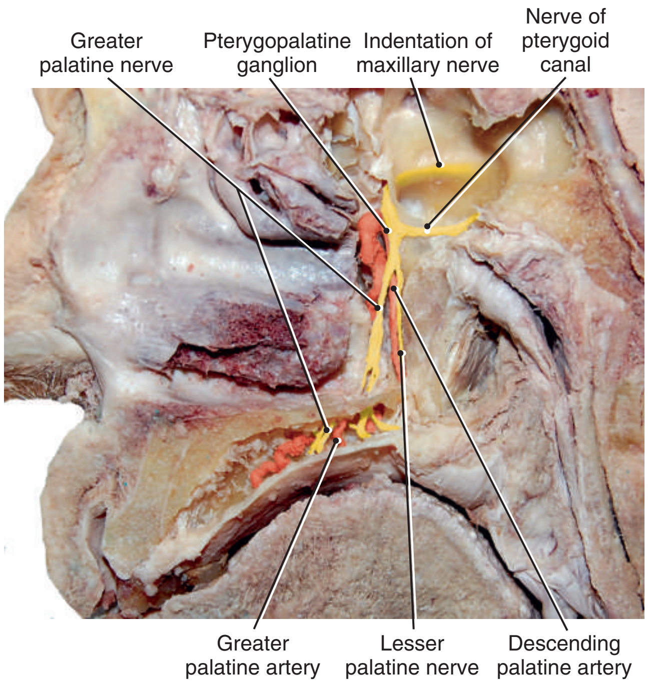

Greater palatine nerve
Pterygopalatine ganglion
Indentation of maxillary nerve
Nerve of pterygoid canal
Greater palatine artery
Lesser palatine nerve
Descending palatine artery

Fig. 26.22 Sagittal view of nasal cavity highlighting osteotomy of perpendicular plate of palatine bone, to show pterygopalatine fossa with pterygopalatine ganglion, nerve of pterygoid canal, greater and lesser palatine nerves and arteries, and descending palatine artery.

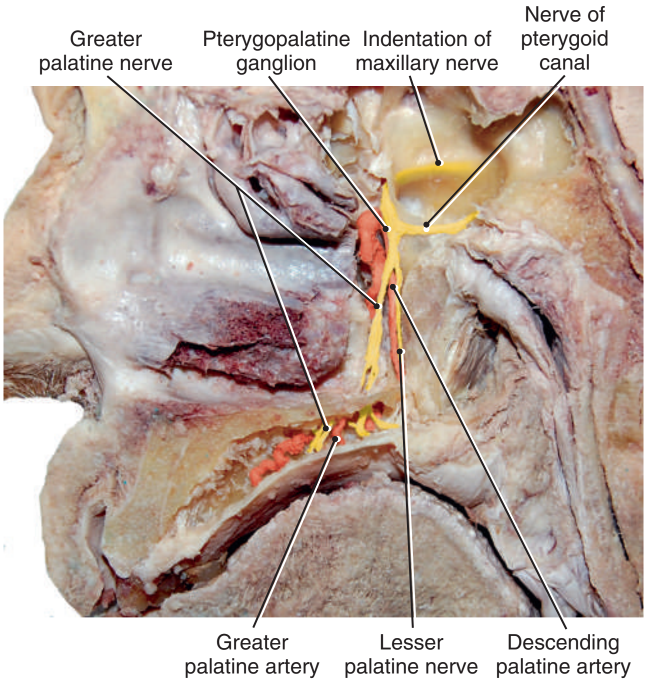
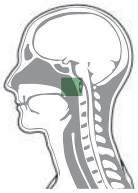

Greater palatine nerve
Pterygopalatine ganglion
Indentation of maxillary nerve
Nerve of pterygoid canal
Greater palatine artery
Lesser palatine nerve
Descending palatine artery

Fig. 26.21 Sagittal view of nasal cavity highlighting osteotomy of perpendicular plate of palatine bone and the sphenoidal sinus and revealing pterygopalatine fossa with pterygopalatine ganglion, nerve of pterygoid canal, greater palatine nerve, descending palatine artery, and maxillary nerve.



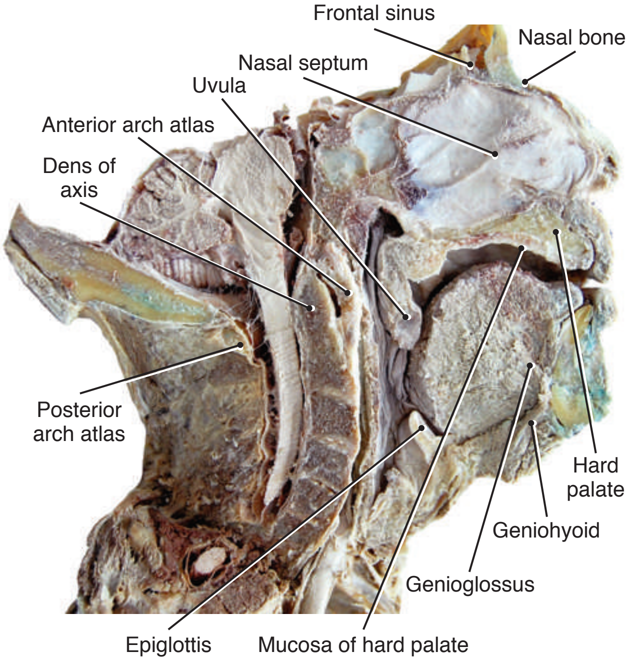

Frontal sinus
Nasal bone
Nasal septum
Uvula
Anterior arch atlas
Dens of axis
Posterior arch atlas
Hard palate
Geniohyoid
Genioglossus
Epiglottis
Mucosa of hard palate

Fig. 26.23 Sagittal view of nasal and oral cavities revealing nasal septum and sphenoidal/frontal sinuses. Oral cavity reveals hard palate, soft palate, uvula, pharynx, floor of tongue muscles (genioglossus, geniohyoid), and epiglottis.

- Remove the mucous membranes from the exposed surface of the nasal septum (Fig. 26.24).
- Identify the septal cartilage, perpendicular plate of the ethmoid bone, and the vomer bone (Fig. 26.25).

DISSECTION **TIP**

Usually, it is difficult and time-consuming to find any of the nerves or vessels on the nasal mucosa, because of drying and shrinkage from fixation.

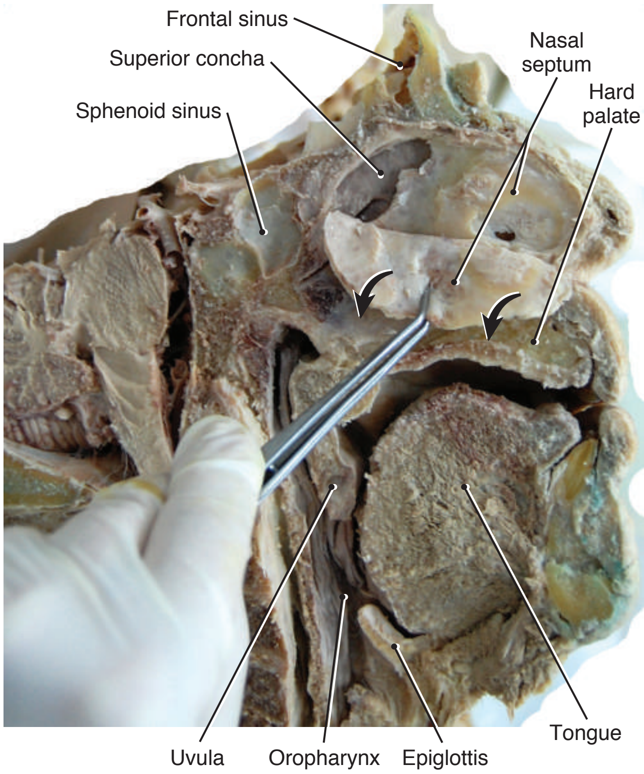

Frontal sinus
Superior concha
Sphenoid sinus
Nasal septum
Hard palate
Uvula
Oropharynx
Epiglottis
Tongue

Fig. 26.24 Sagittal view of nasal and oral cavities with nasal septum reflected, revealing superior concha, vomer bone, sphenoidal sinus, and frontal sinus. Oral cavity reveals tongue, floor of tongue muscles, uvula, epiglottis, and pharynx.

Identify the following:

- 1. *Sphenoethmoidal recess,* posterior to the superior concha, the location of the opening for the sphenoidal sinus
- 2. *Superior nasal meatus,* beneath the superior concha, the opening for the posterior ethmoidal cells
- 3. *Middle nasal meatus,* the ethmoidal bulla, with openings for middle ethmoid cells and the maxillary sinus
- 4. *Inferior nasal meatus,* the opening of the nasolacrimal duct
- 5. *Ethmoidal infundibulum,* for the opening of the frontonasal duct from the frontal sinus
- 6. *Hiatus semilunaris,* the semilunar hiatus, the long, crescent-shaped opening for the anterior ethmoidal cells

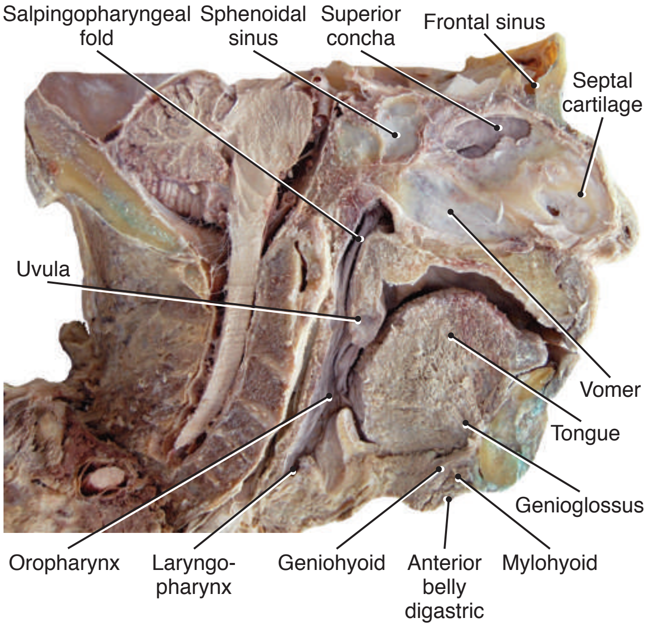

Salpingopharyngeal fold
Sphenoidal sinus
Superior concha
Frontal sinus
Septal cartilage
Uvula
Vomer
Tongue
Genioglossus
Oropharynx
Laryngo-pharynx
Geniohyoid
Anterior belly digastric
Mylohyoid

Fig. 26.25 Sagittal view of nasal and oral cavities revealing sphenoidal and frontal sinuses, septal cartilage, vomer bone, superior concha, and nasal pharynx. Oral cavity reveals uvula, tongue, and genioglossus, geniohyoid, mylohyoid, and anterior belly of digastric muscles.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Nerve of pterygoid canal
- ☐ Greater palatine
- ☐ Lesser palatine
- ☐ Maxillary

ARTERIES

- ☐ Sphenopalatine
  - ☐ Descending palatine
    - ☐ Greater palatine
    - ☐ Lesser palatine

MUSCLES

- ☐ Tensor veli palatini
- ☐ Levator veli palatini
- ☐ Salpingopharyngeus

BONES

- ☐ Nasal
- ☐ Frontal
- ☐ Ethmoid
  - ☐ Cribriform plate
  - ☐ Perpendicular plate
- ☐ Sphenoid
- ☐ Palatine
  - ☐ Horizontal plate
  - ☐ Perpendicular plate
- ☐ Palatine process of maxilla
- ☐ Vomer
- ☐ Conchae
  - ☐ Superior
  - ☐ Middle
  - ☐ Inferior

SINUSES

- ☐ Sphenoidal
- ☐ Ethmoidal
  - ☐ Posterior cells
  - ☐ Middle cells
  - ☐ Anterior cells
- ☐ Frontal
- ☐ Maxillary

DRAINAGE PATHWAYS

- ☐ Sphenoethmoidal recess
- ☐ Superior meatus
- ☐ Middle meatus
- ☐ Inferior meatus
- ☐ Ethmoidal bulla
- ☐ Semilunar hiatus
- ☐ Nasolacrimal duct
- ☐ Sphenopalatine foramen
- ☐ Maxillary sinus ostium
- ☐ Nares (nostrils)
  - ☐ Choanae
  - ☐ Vestibule

GANGLION

- ☐ Pterygopalatine

OTHER STRUCTURES

- ☐ Basion
- ☐ Clivus
- ☐ Dens
- ☐ Epiglottis
- ☐ Torus tubarius
- ☐ Uvula
- ☐ Septal cartilage

CHAPTER 27 PHARYNX AND ORAL CAVITY

ATLAS REFERENCES

Netter: 65–72, 77, 81–86
McMinn: 46, 52
Gray's Atlas: 552–557, 572–582

DISSECTION STEPS

- Identify the borders of the nasopharynx, oropharynx, and laryngopharynx on the cadaver (Fig. 27.1).
- The tensor veli palatini and the levator veli palatini muscles have been identified during the dissection of the pterygopalatine fossa (see Fig. 27.1 and Chapter 26).
- Identify the *torus tubarius,* a cartilaginous elevation of the auditory tube (see Figs. 27.4 and 27.1), and locate the pharyngeal tonsil superior to it.
- Extending inferiorly from the torus tubarius is the *salpingopharyngeal fold,* formed by the underlying salpingopharyngeus muscle (see Fig. 27.3 and Plate 27.1).
- Locate the borders of the tonsillar fossa in the oropharynx and identify the palatine tonsil bounded by two arches. Anteriorly, observe the *palatoglossal arch,* a mucosal fold formed by the palatoglossus muscle (see Fig. 27.1).
- Posteriorly, a second arch, the *palatopharyngeal arch,* is formed by a mucosal fold from the underlying palatopharyngeus muscle (see Fig. 27.1).
- In the tonsillar fossa, use your forceps to lift the mucous membrane and pull it off of the underlying musculature (Fig. 27.2).
- Similarly, remove the mucous membrane and expose the palatopharyngeus muscle (see Fig. 27.2).

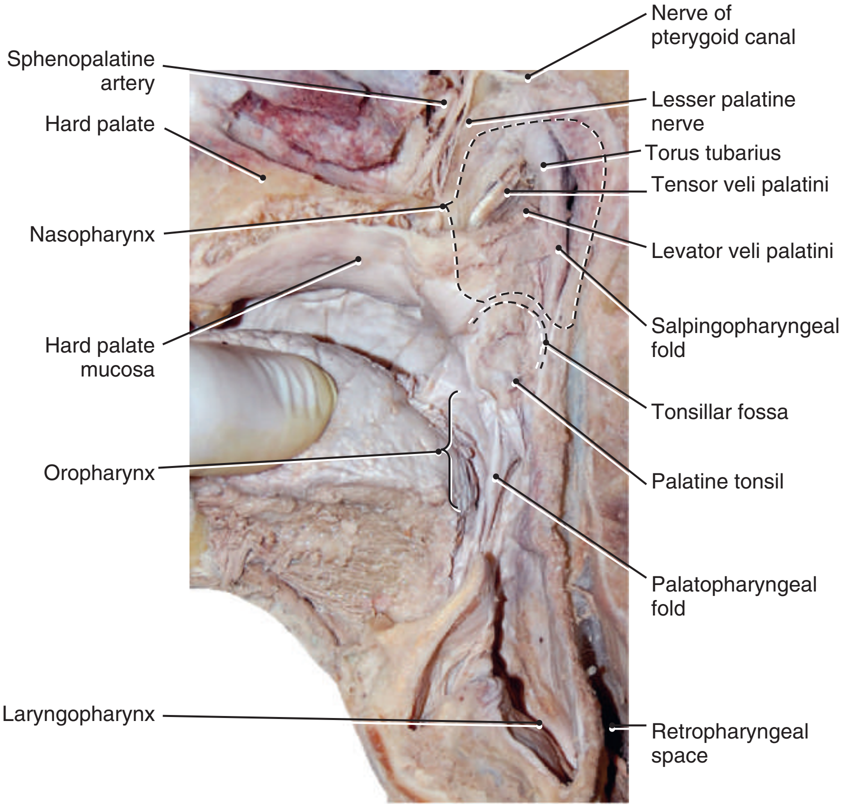

Nerve of pterygoid canal
Sphenopalatine artery
Lesser palatine nerve
Hard palate
Torus tubarius
Tensor veli palatini
Nasopharynx
Levator veli palatini
Hard palate mucosa
Salpingopharyngeal fold
Tonsillar fossa
Oropharynx
Palatine tonsil
Palatopharyngeal fold
Laryngopharynx
Retropharyngeal space

Fig. 27.1 Sagittal view of oral cavity, including nasal and pharyngeal regions, revealing hard palate, nasopharynx region, hard palate mucosa, oral pharynx region, laryngopharynx region, retropharyngeal space, and salpingopharyngeal fold.

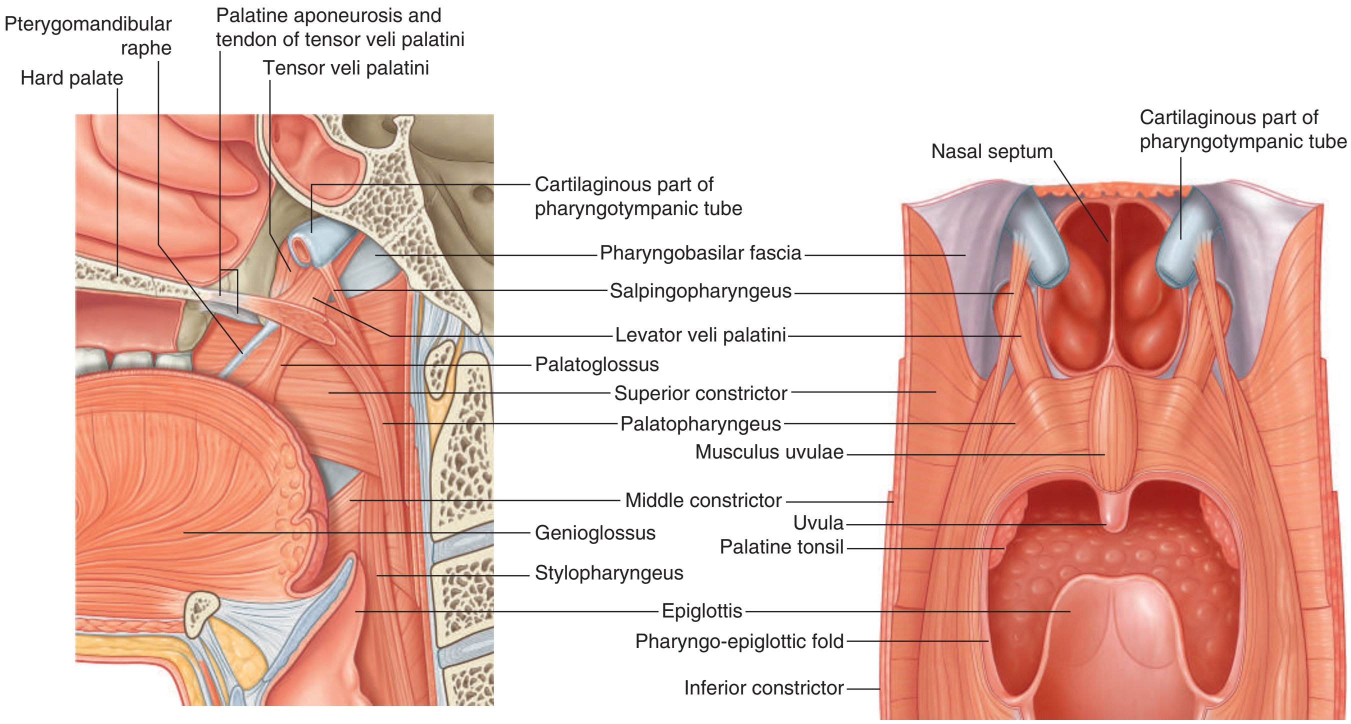

Pterygomandibular raphe
Palatine aponeurosis and tendon of tensor veli palatini
Hard palate
Tensor veli palatini
Cartilaginous part of pharyngotympanic tube
Nasal septum
Cartilaginous part of pharyngotympanic tube
Pharyngobasilar fascia
Salpingopharyngeus
Levator veli palatini
Palatoglossus
Superior constrictor
Palatopharyngeus
Musculus uvulae
Middle constrictor
Uvula
Genioglossus
Palatine tonsil
Stylopharyngeus
Epiglottis
Pharyngo-epiglottic fold
Inferior constrictor

Plate 27.1 Muscles of soft palate, sagittal and posterior views.

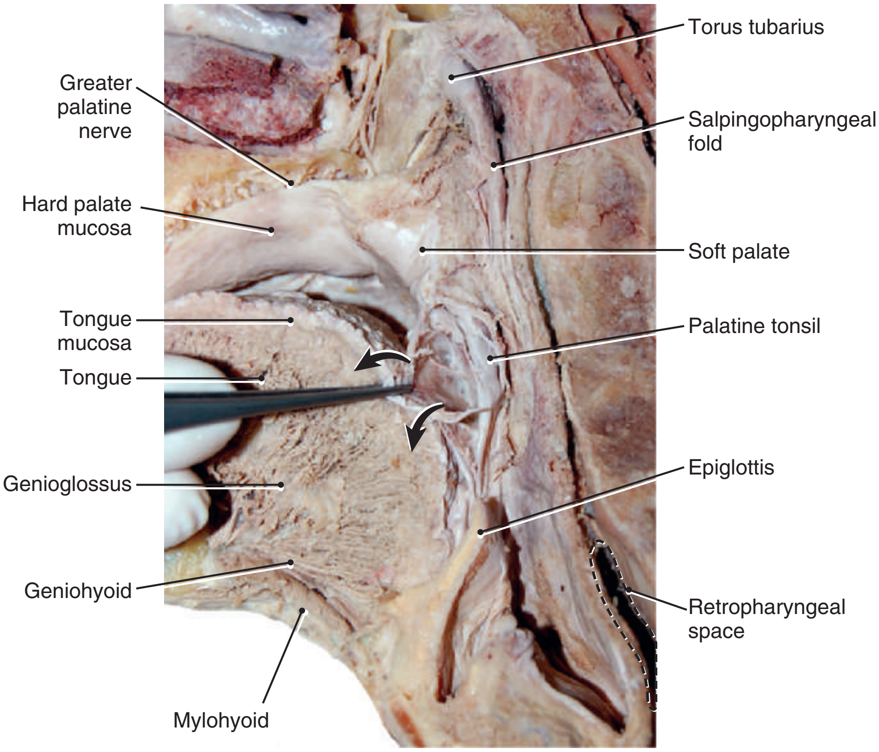
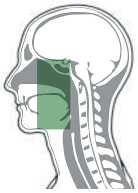

Torus tubarius
Greater palatine nerve
Salpingopharyngeal fold
Hard palate mucosa
Soft palate
Tongue mucosa
Palatine tonsil
Tongue
Genioglossus
Epiglottis
Geniohyoid
Retropharyngeal space
Mylohyoid

Fig. 27.2 Removal of mucous membranes and exposure of underlying musculature.



DISSECTION **TIP**

In the laryngopharynx, at the level of the epiglottis, the palatopharyngeus, salpingopharyngeus, and stylopharyngeus muscles give the impression that they blend and fuse with the posterior pharyngeal constrictor muscles (see Fig. 27.2). However, the posterior pharyngeal constrictors are separated from these muscles by a thin fascia, the *buccopharyngeal fascia.* In some specimens, this fascia may appear as a white vertical line.

- Pull the palatine tonsil forward, and expose the palatopharyngeus muscle (Fig. 27.3).
- Continue the dissection by removing the mucous membranes from the palatoglossal arch, and expose the palatoglossus muscle (Fig. 27.4).
- Because this muscle is located deep and lateral to the tongue, pull the tongue forward and the palatine tonsil backward to expose it fully.
- Divide the palatoglossus muscle, and identify the glossopharyngeal nerve (Fig. 27.5).
- At the base of the tongue, identify the *lingual tonsil.*

DISSECTION **TIP**

To find the glossopharyngeal nerve, place your thumb at the lateral border of the epiglottis, between the palatine tonsil and the epiglottis. Split the palatoglossus muscle lateral to your thumb (see Fig. 27.5).

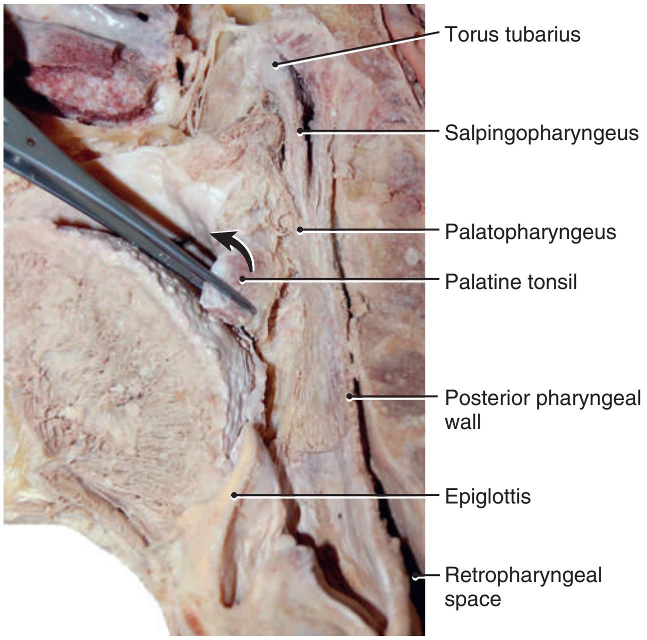
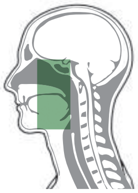

Torus tubarius
Salpingopharyngeus
Palatopharyngeus
Palatine tonsil
Posterior pharyngeal wall
Epiglottis
Retropharyngeal space

Fig. 27.3 Musculature of palatine tonsil reflected anteriorly, exposing the salpingopharyngeus, palatopharyngeus, and posterior pharyngeal wall.



- Identify the space between the epiglottis and the tongue. Look for a membranous ridge, the *median glossoepiglottic fold,* connecting the posterior surface of the tongue to the epiglottis (Fig. 27.6).

ANATOMY **NOTE**

This fold divides the area between the epiglottis and the tongue into two spaces, the *valleculae* (see Fig. 27.6).

INSPECTION

ANATOMY **NOTE**

The oral cavity occupies the space between the lips anteriorly and the palatoglossal folds posteriorly. For descriptive purposes, the oral cavity is also divided into the vestibule and the oral cavity proper. The *vestibule* includes the area between the external surfaces of the teeth and the internal surface of cheeks. The *oral cavity proper* is the space filled by the tongue.

- Pull the tongue toward the midline and note the *vestibule.*
- Identify the mucous membrane, the *frenulum,* between the inferior aspect of the tongue and the floor of the mouth (Fig. 27.7).
- Lateral to the frenulum, identify multiple tributaries of the lingual veins and orifices of the submandibular glands, the *sublingual* papilla (sublingual *caruncle*).
- Continue the inspection of the anterior surface of the tongue, and identify the *filiform* papillae.
- Appreciate the much larger and sometimes reddish *fungiform* papillae.

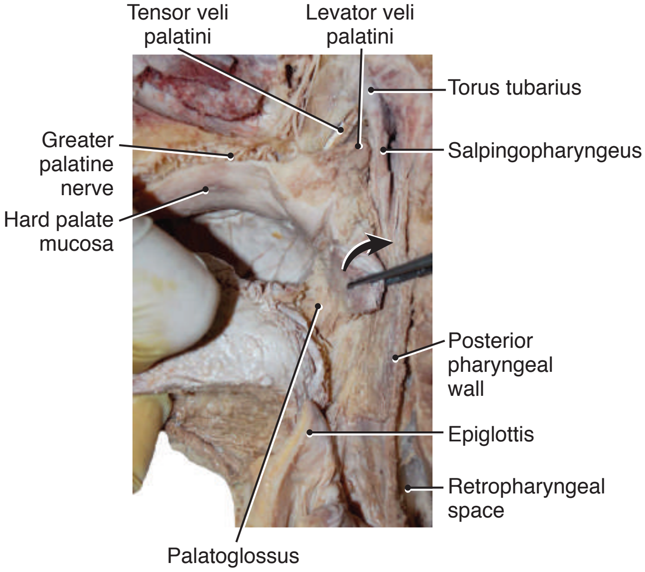
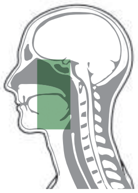

Tensor veli palatini
Levator veli palatini
Torus tubarius
Greater palatine nerve
Salpingopharyngeus
Hard palate mucosa
Posterior pharyngeal wall
Epiglottis
Retropharyngeal space
Palatoglossus

Fig. 27.4 Musculature of palatine tonsil reflected posteriorly, exposing the palatoglossal fold and palatoglossus muscle.



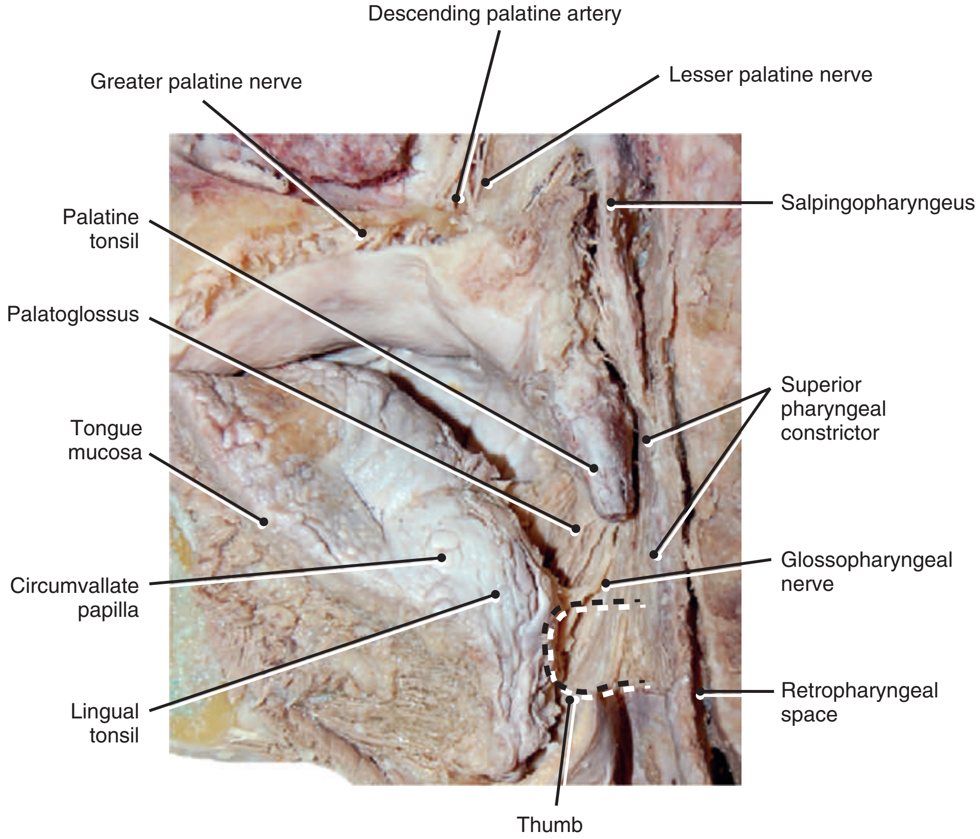

Descending palatine artery
Greater palatine nerve
Lesser palatine nerve
Palatine tonsil
Salpingopharyngeus
Palatoglossus
Superior pharyngeal constrictor
Tongue mucosa
Circumvallate papilla
Glossopharyngeal nerve
Lingual tonsil
Retropharyngeal space
Thumb

Fig. 27.5 To find the glossopharyngeal nerve, the thumb is placed *(dashed area)* lateral to the epiglottis between it and the palatine tonsil.

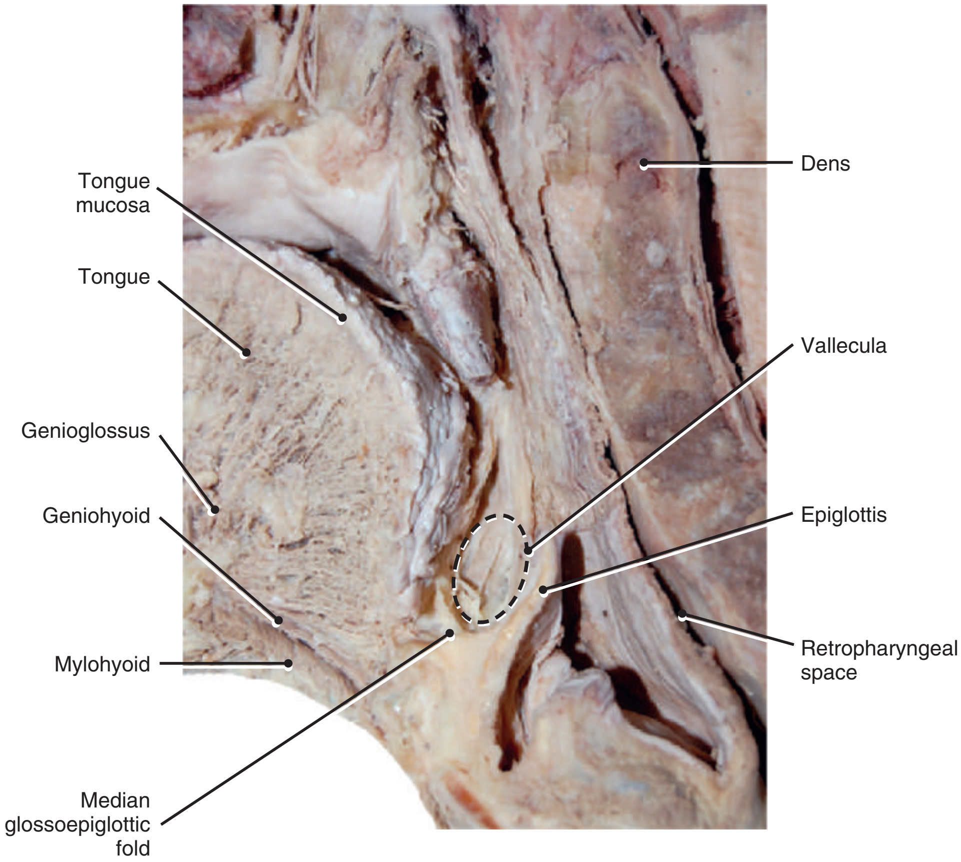
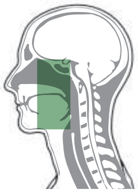

Dens
Tongue mucosa
Tongue
Vallecula
Genioglossus
Geniohyoid
Epiglottis
Mylohyoid
Retropharyngeal space
Median glossoepiglottic fold

Fig. 27.6 Appreciate the connection between the tongue and epiglottis, the median glossoepiglottic fold, and spaces lateral to it (valleculae).



- At the posterior surface of the tongue, identify the sulcus terminalis and *vallate* papillae.
- At the midpoint of the sulcus terminalis, attempt to visualize the *foramen cecum* (Fig. 27.8 and Plate 27.2).
- Pull the tongue medially and make a shallow incision through the mucous membranes lateral to the tongue alongside the mandible (Fig. 27.9).

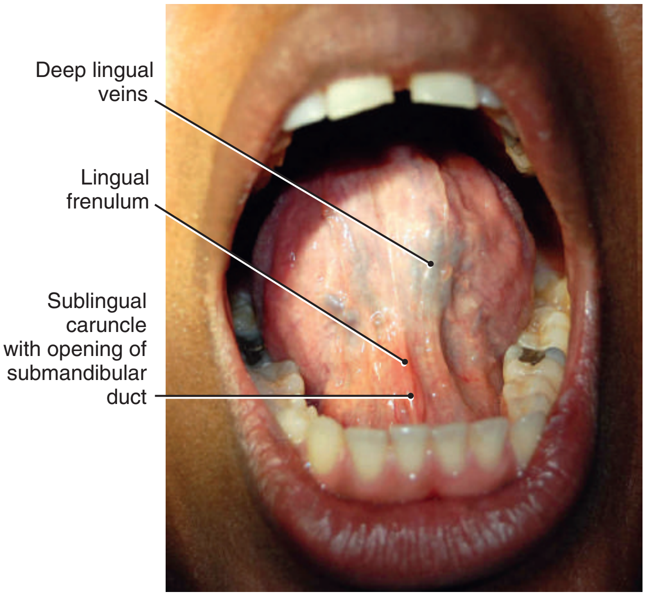

Deep lingual veins
Lingual frenulum
Sublingual caruncle with opening of submandibular duct

Fig. 27.7 Appreciate the lingual frenulum, deep lingual vein, and submandibular duct.

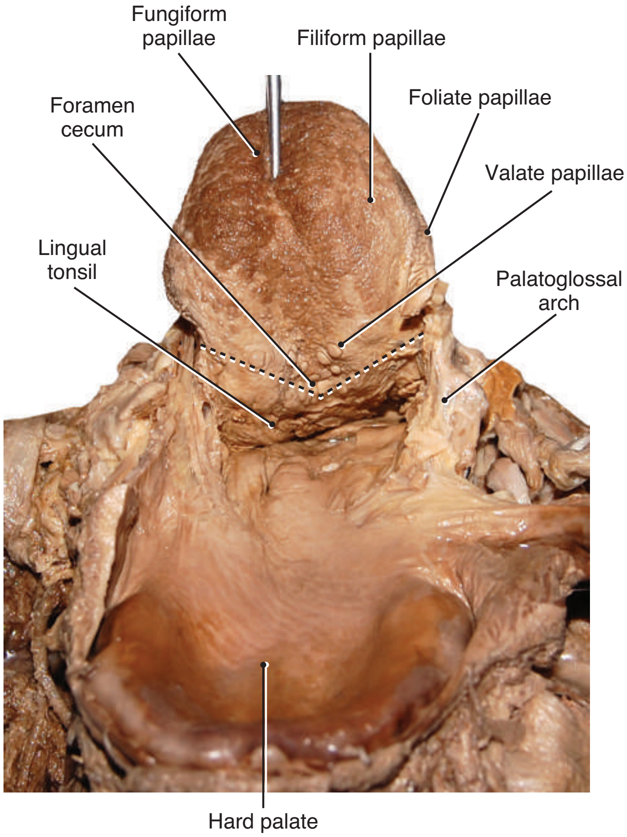

Fungiform papillae
Filiform papillae
Foramen cecum
Foliate papillae
Valate papillae
Lingual tonsil
Palatoglossal arch
Hard palate

Fig. 27.8 Hard palate reflected posteriorly with view from above revealing filiform, fungiform, and foliate papillae, and at the posterior third of the tongue, the sulcus terminalis (dashed line) and 10 to 12 vallate papillae.

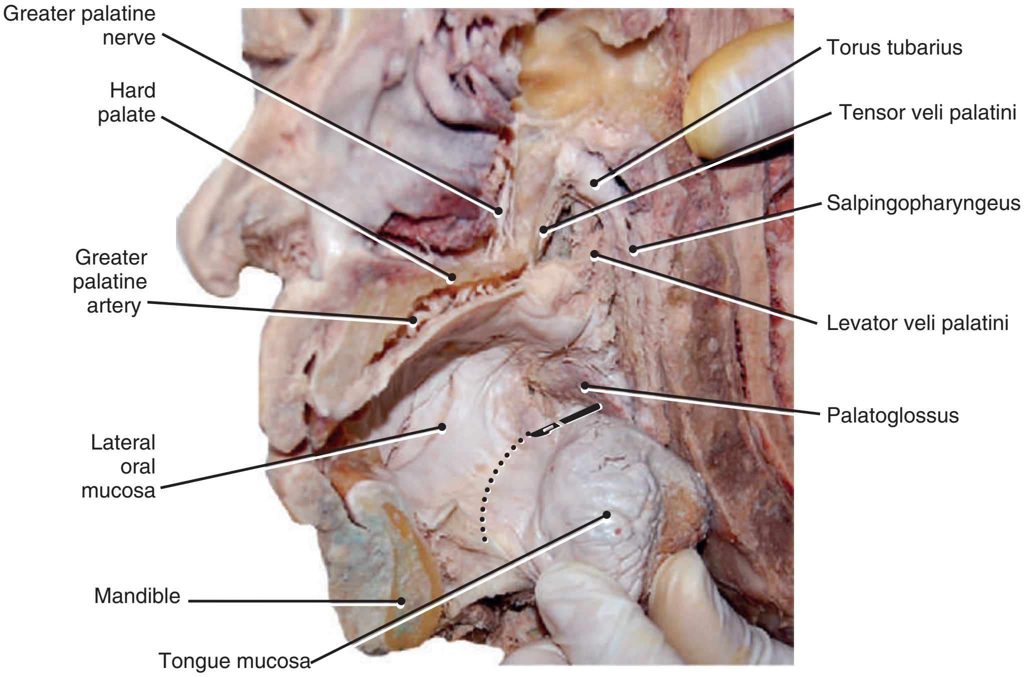

Greater palatine nerve
Hard palate
Greater palatine artery
Lateral oral mucosa
Mandible
Tongue mucosa
Torus tubarius
Tensor veli palatini
Salpingopharyngeus
Levator veli palatini
Palatoglossus

Fig. 27.9 Tongue pulled medially with shallow incision *(dotted line)* through mucous membranes lateral to tongue alongside mandible.

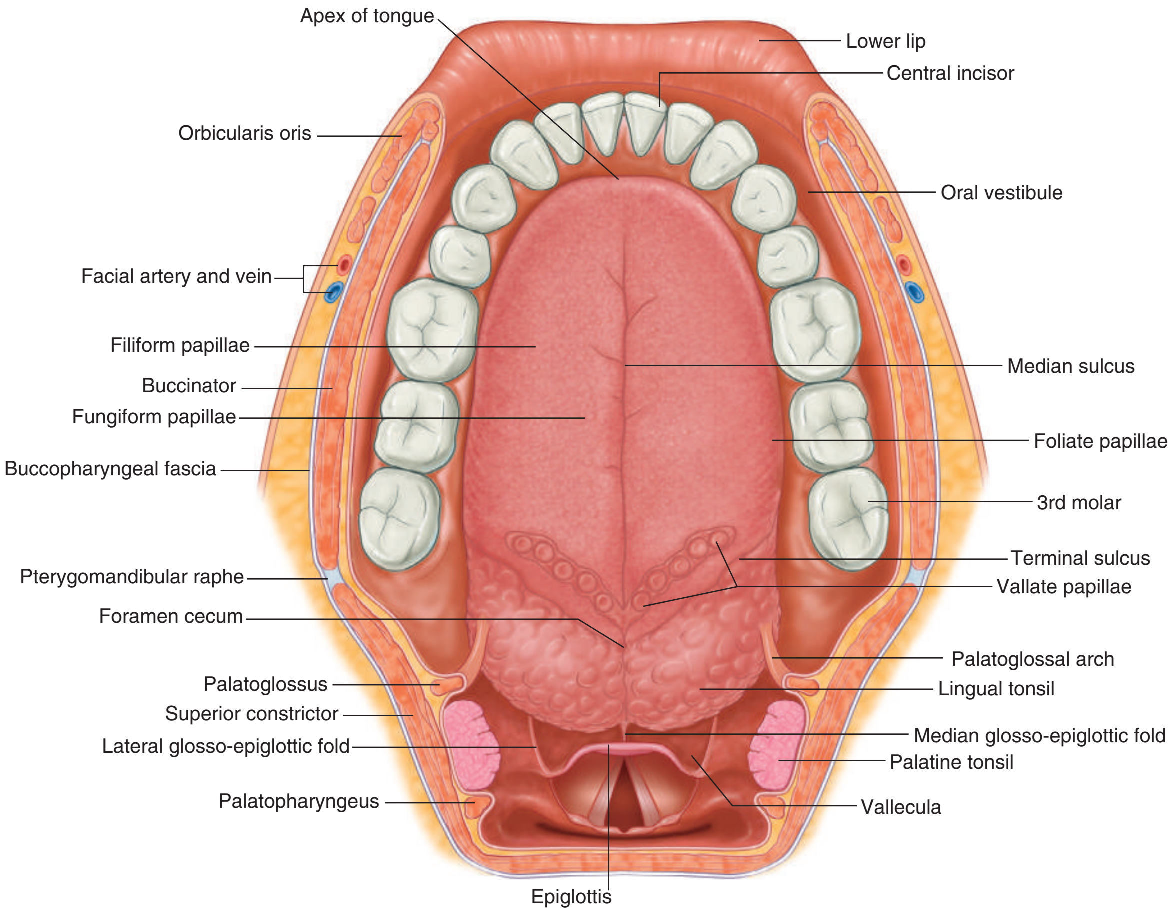

Apex of tongue
Lower lip
Central incisor
Orbicularis oris
Oral vestibule
Facial artery and vein
Filiform papillae
Median sulcus
Buccinator
Fungiform papillae
Foliate papillae
Buccopharyngeal fascia
3rd molar
Terminal sulcus
Pterygomandibular raphe
Vallate papillae
Foramen cecum
Palatoglossal arch
Palatoglossus
Lingual tonsil
Superior constrictor
Median glosso-epiglottic fold
Lateral glosso-epiglottic fold
Palatine tonsil
Palatopharyngeus
Vallecula
Epiglottis

Plate 27.2 Horizontal section showing superior view of tongue.

- Extend the incision toward the palatoglossus but do not sever this muscle (Fig. 27.10).
- Lift the mucous membranes of the vestibule and expose the mylohyoid muscle (Fig. 27.11).
- Appreciate neuromuscular structures with the mylohyoid muscle exposed.
- In the space between the palatoglossus and mylohyoid muscles, identify the *lingual nerve* descending from the infratemporal fossa into the floor of the mouth (Figs. 27.12 and 27.13). Clean the soft tissues and mucous membranes around the lingual nerve.

DISSECTION **TIP**

The dissection of the lingual nerve also continues from the floor of the mouth. Therefore do not attempt to dissect the nerve too deeply.

- Make an incision through the mucous membrane of the floor of the mouth between the geniohyoid and mylohyoid muscles (Figs. 27.14 and 27.15), and identify the *lingual artery* (Fig. 27.16).
- As the mucous membranes are reflected laterally from the midline, identify the *submandibular duct* (Wharton's duct) and the *sublingual gland.*
- Expose the submandibular duct posteriorly to its origin from the submandibular gland, around the posterior edge of the mylohyoid muscle (Fig. 27.17).
- Distal to the tortuous lingual artery, identify the lingual nerve.

ANATOMY **NOTE**

The lingual nerve passes medially toward the tongue as it crosses over the submandibular duct (Fig. 27.18).

- Posterior to the tongue, expose the hypoglossal nerve.
- Pull the tongue posteriorly and expose the mylohyoid muscle (Fig. 27.19).
- Trace the lingual nerve as it descends from the infratemporal fossa between the palatoglossus and mylohyoid muscles. Note the submandibular duct crossing the lingual nerve (Fig. 27.20).

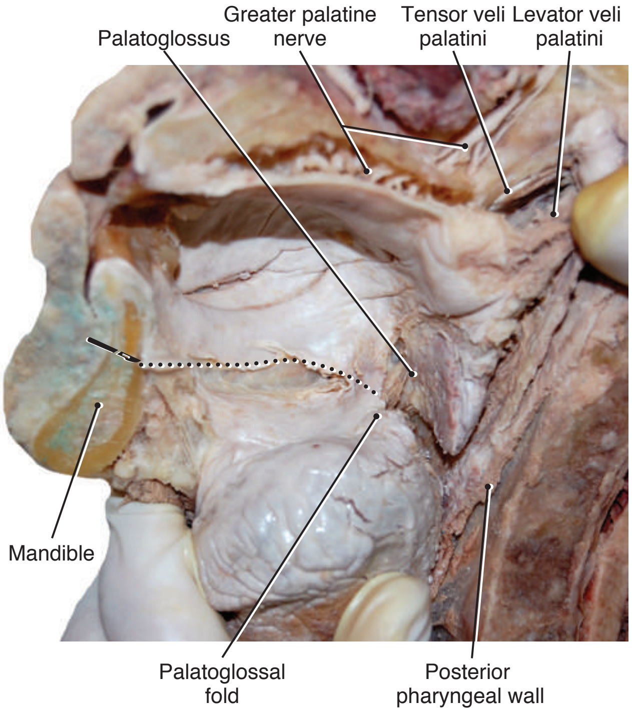
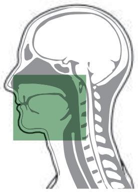

Palatoglossus
Greater palatine nerve
Tensor veli palatini
Levator veli palatini
Mandible
Palatoglossal fold
Posterior pharyngeal wall

Fig. 27.10 Incision extended toward palatoglossus muscle.



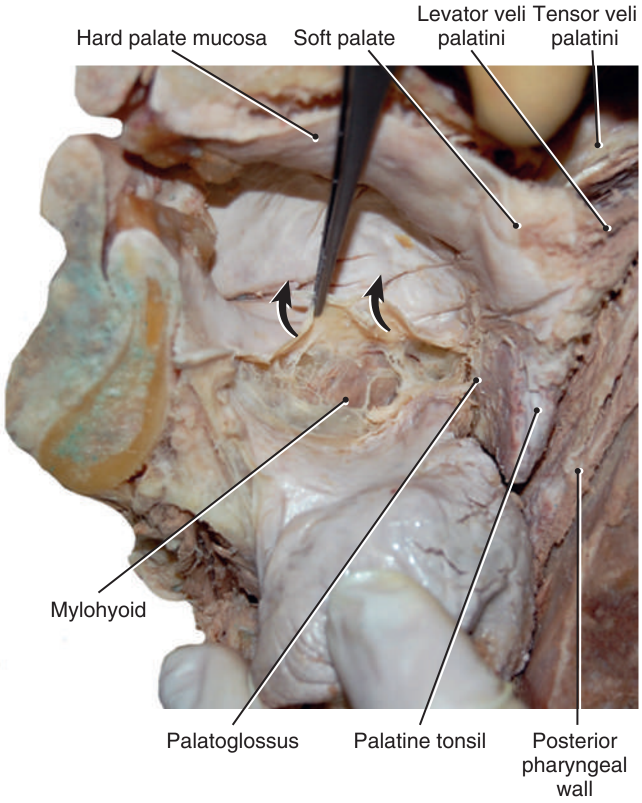
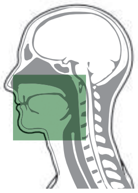

Hard palate mucosa
Soft palate
Levator veli palatini
Tensor veli palatini
Mylohyoid
Palatoglossus
Palatine tonsil
Posterior pharyngeal wall

Fig. 27.11 Mucous membranes of vestibule lifted, exposing the mylohyoid muscle.



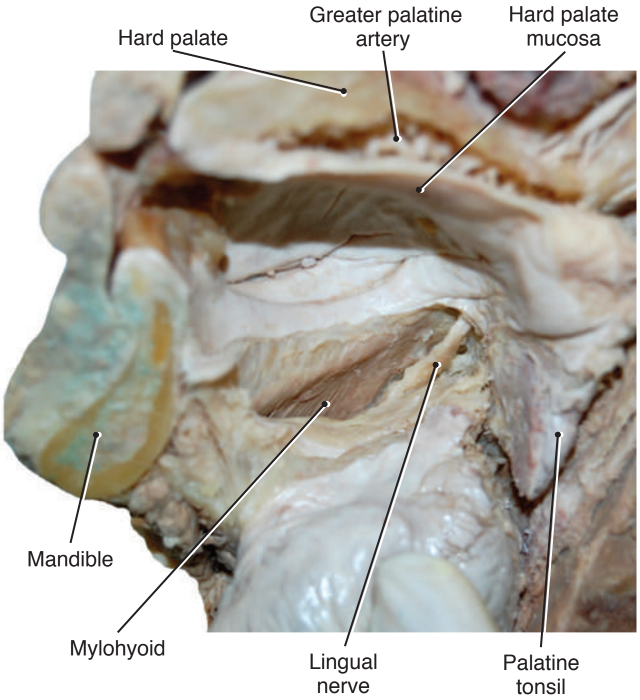
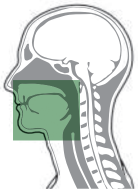

Hard palate
Greater palatine artery
Hard palate mucosa
Mandible
Mylohyoid
Lingual nerve
Palatine tonsil

Fig. 27.12 Appreciate the lingual nerve descending from the infratemporal fossa into the floor of the mouth, between palatoglossus and mylohyoid muscles.



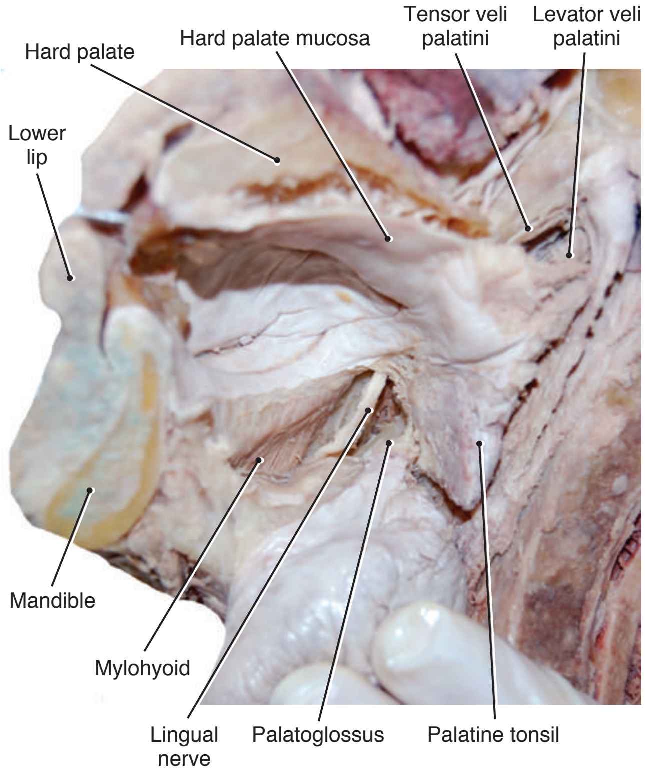
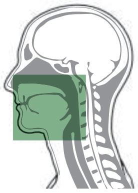

Hard palate
Hard palate mucosa
Tensor veli palatini
Levator veli palatini
Lower lip
Mandible
Mylohyoid
Lingual nerve
Palatoglossus
Palatine tonsil

Fig. 27.13 Soft tissues and mucous membranes cleaned around lingual nerve.



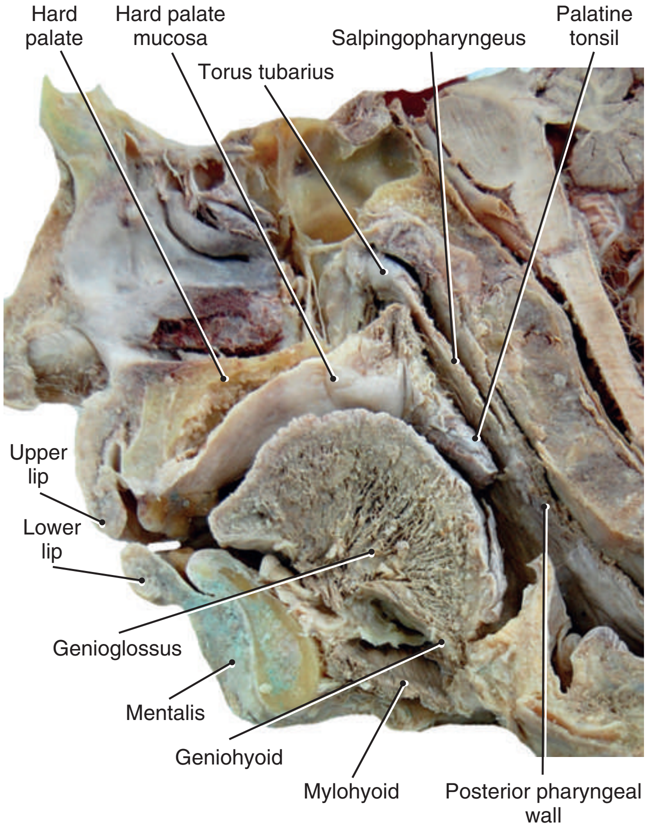

Hard palate
Hard palate mucosa
Torus tubarius
Salpingopharyngeus
Palatine tonsil
Upper lip
Lower lip
Genioglossus
Mentalis
Geniohyoid
Mylohyoid
Posterior pharyngeal wall

Fig. 27.14 Sagittal view of oral cavity, including nasal and pharyngeal regions, revealing hard palate mucosa, upper/lower lips, uvula, and mentalis, genioglossus, geniohyoid, mylohyoid, and salpingopharyngeus muscles.

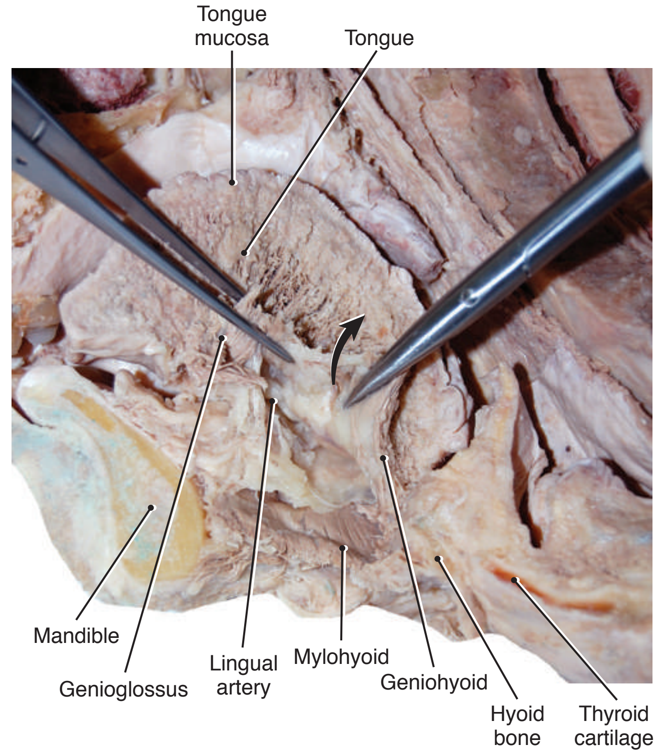

Tongue mucosa
Tongue
Mandible
Genioglossus
Lingual artery
Mylohyoid
Geniohyoid
Hyoid bone
Thyroid cartilage

Fig. 27.15 Geniohyoid muscle lifted upward to clean soft tissues underneath.

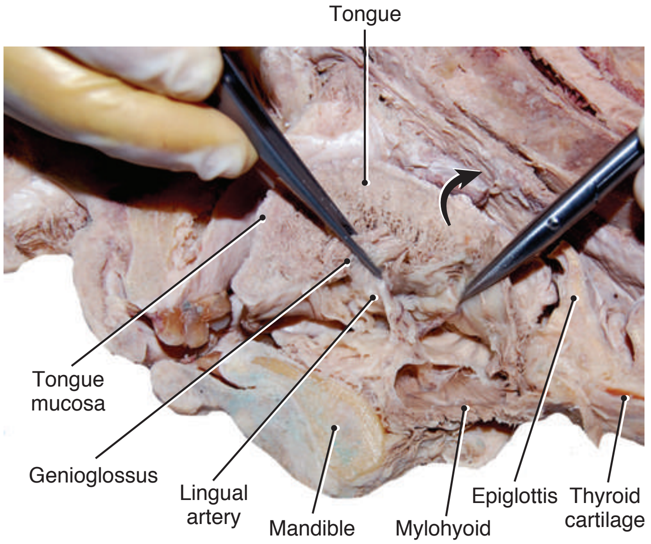

Tongue
Tongue mucosa
Genioglossus
Lingual artery
Mandible
Mylohyoid
Epiglottis
Thyroid cartilage

Fig. 27.16 Sagittal view of oral cavity revealing mucosa of tongue, tongue, genioglossus muscle, lingual artery, mandible, mylohyoid muscle, hyoid bone, and epiglottis.

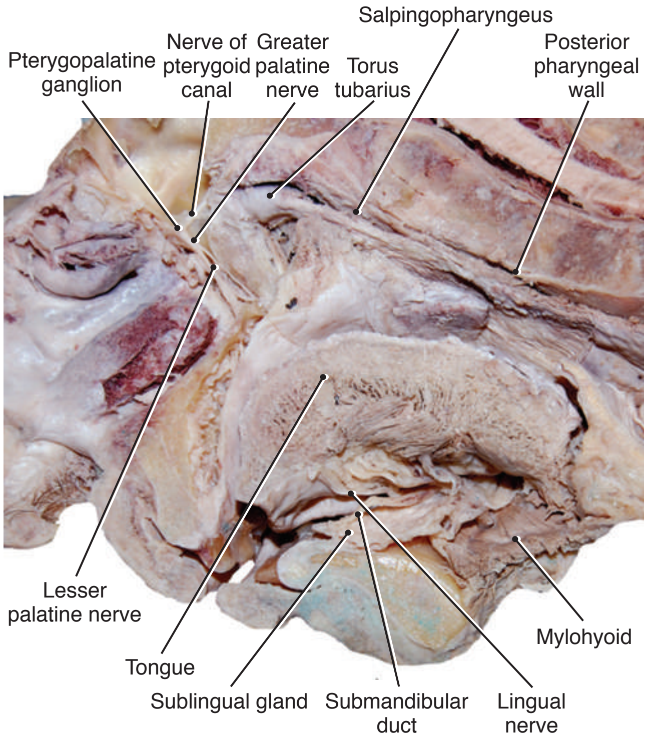

Pterygopalatine ganglion
Nerve of pterygoid canal
Greater palatine nerve
Torus tubarius
Salpingopharyngeus
Posterior pharyngeal wall
Lesser palatine nerve
Tongue
Sublingual gland
Submandibular duct
Lingual nerve
Mylohyoid

Fig. 27.17 Submandibular duct exposed posteriorly from origin at submandibular gland around posterior edge of the mylohyoid muscle.

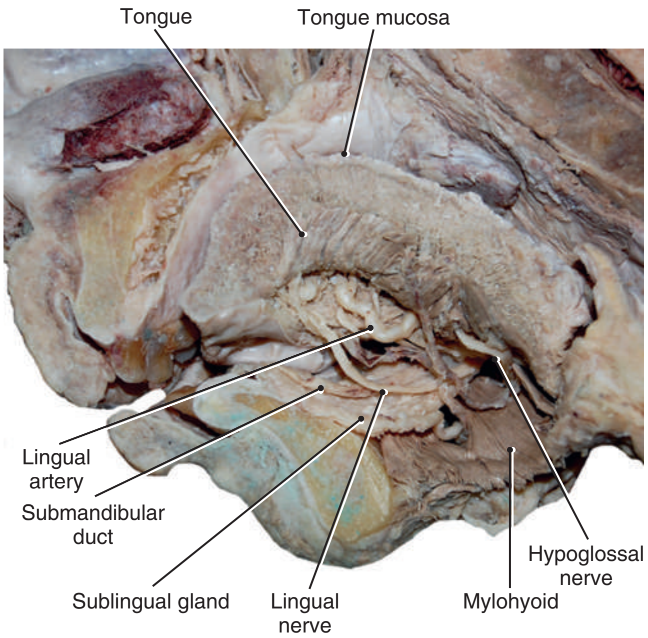

Tongue
Tongue mucosa
Lingual artery
Submandibular duct
Sublingual gland
Lingual nerve
Mylohyoid
Hypoglossal nerve

Fig. 27.18 Appreciate lingual nerve distal to tortuous lingual artery, passing medially toward tongue and crossing over submandibular duct, and hypoglossal nerve posteriorly.

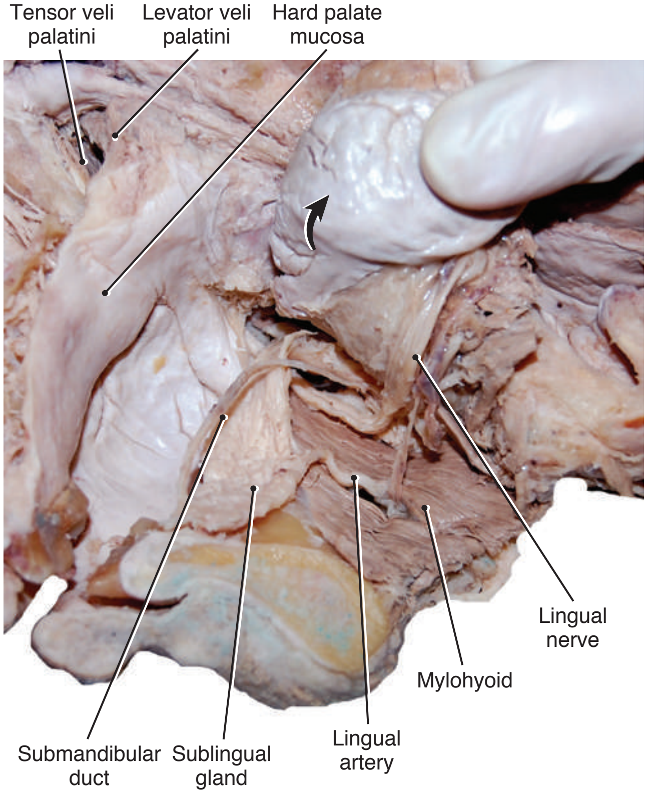

Tensor veli palatini
Levator veli palatini
Hard palate mucosa
Lingual nerve
Mylohyoid
Submandibular duct
Sublingual gland
Lingual artery

Fig. 27.19 Tongue pulled posteriorly, exposing mylohyoid muscle.

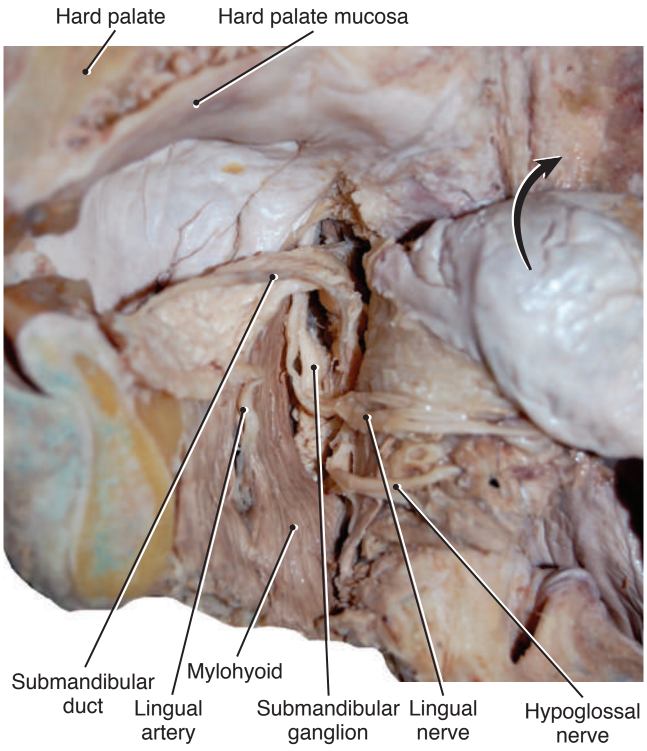

Hard palate
Hard palate mucosa
Submandibular duct
Mylohyoid
Lingual artery
Submandibular ganglion
Lingual nerve
Hypoglossal nerve

Fig. 27.20 Appreciate lingual nerve descending from infratemporal fossa and submandibular duct crossing over it.

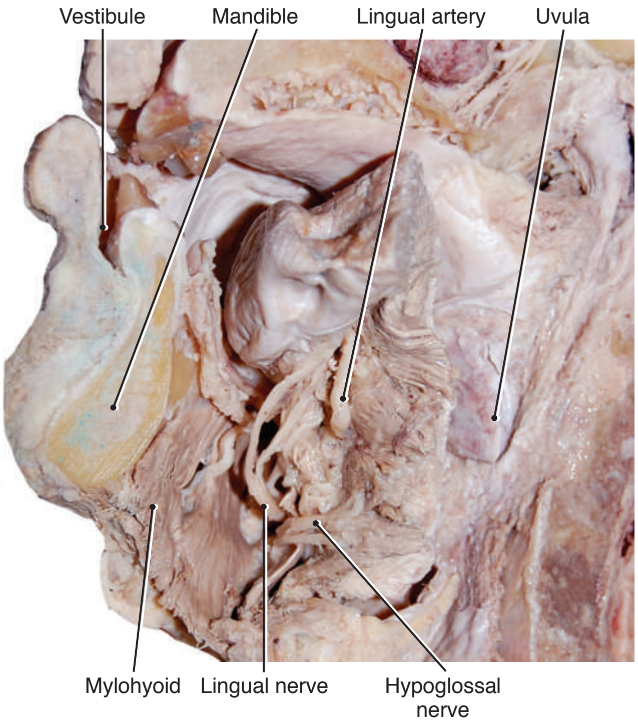
- ○ **With the tongue pulled posteriorly, dissect between the lingual nerve and submandibular gland, and expose the *submandibular ganglion* (see Fig. 27.20).**

DISSECTION **TIP**

The following landmarks help to identify the different structures in the floor of the mouth (Figs. 27.21 and 27.22):

- The *lingual artery* passes deep to the hyoglossus muscle and is often tortuous.
- The *hypoglossal nerve* passes superficial to the hyoglossus muscle and is seen at the posterior part of the tongue.
- Seen from the midline with the tongue in situ, the *lingual nerve* passes medially toward the tongue as it crosses over the submandibular duct (see Fig. 27.18).
- With the tongue reflected posteriorly, note the *submandibular duct* crossing over the lingual nerve (see Figs. 27.19 and 27.20 and Plate 27.3).

- ○ **If time permits, separate and expose the hyoglossus, genioglossus, geniohyoid, styloglossus, and mylohyoid muscles.**


Vestibule
Mandible
Lingual artery
Uvula
Mylohyoid
Lingual nerve
Hypoglossal nerve

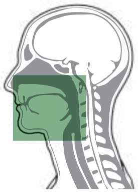


Fig. 27.21 Sagittal view of oral cavity, including nasal and pharyngeal regions, revealing vestibule, lingual artery, hypoglossal nerve, lingual nerve, mylohyoid muscle, uvula, and hyoid bone.

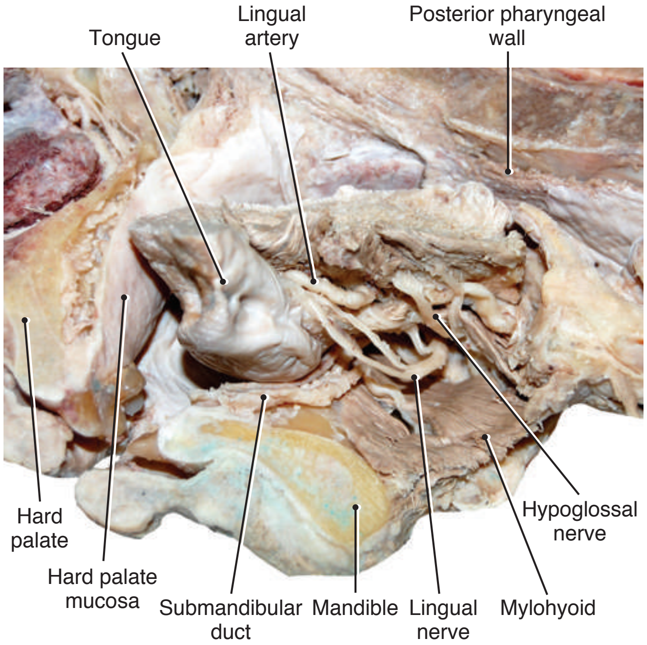

Tongue
Lingual artery
Posterior pharyngeal wall
Hard palate
Hard palate mucosa
Submandibular duct
Mandible
Lingual nerve
Hypoglossal nerve
Mylohyoid

Fig. 27.22 Sagittal view of the oral cavity, highlighting hard palate and mucosa, tongue, hypoglossal nerve, lingual artery and nerve, mylohyoid muscle, and posterior pharyngeal wall.

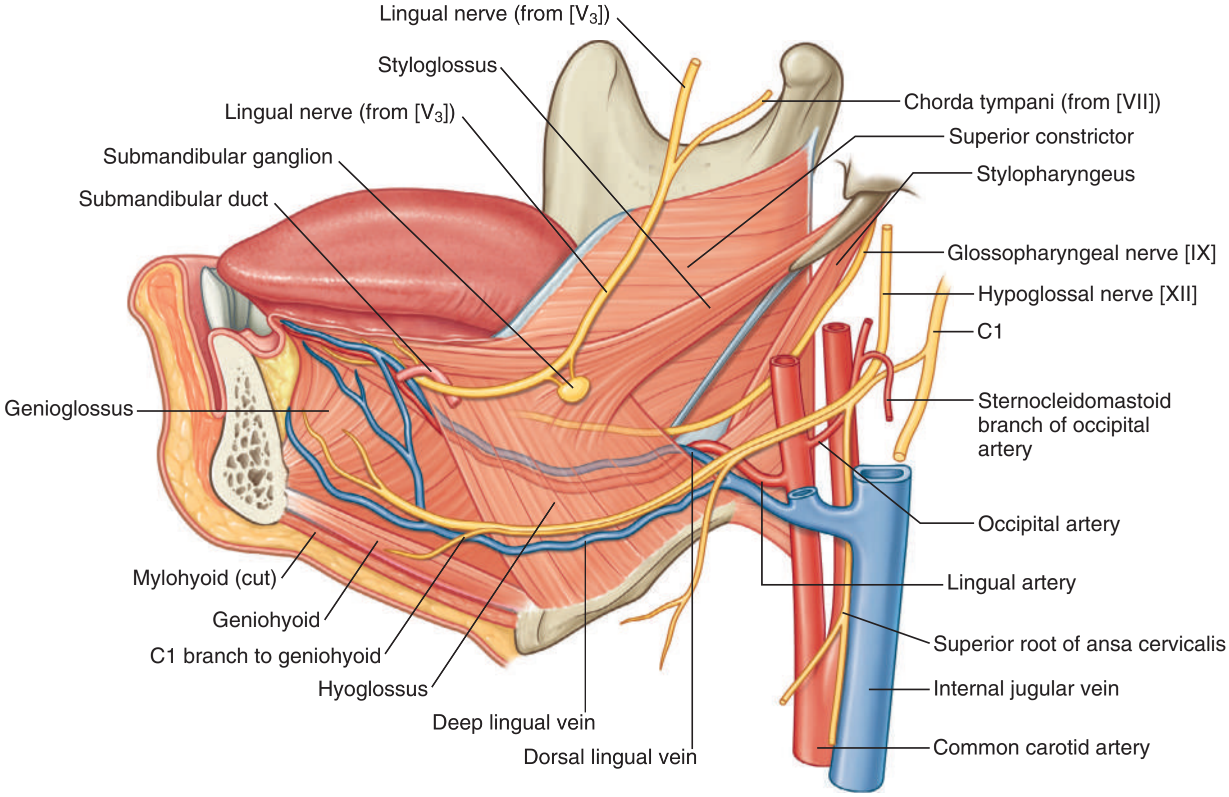

Lingual nerve (from [V_3])
Styloglossus
Lingual nerve (from [V_3])
Submandibular ganglion
Submandibular duct
Genioglossus
Mylohyoid (cut)
Geniohyoid
C1 branch to geniohyoid
Hyoglossus
Deep lingual vein
Dorsal lingual vein
Chorda tympani (from [VII])
Superior constrictor
Stylopharyngeus
Glossopharyngeal nerve [IX]
Hypoglossal nerve [XII]
C1
Sternocleidomastoid branch of occipital artery
Occipital artery
Lingual artery
Superior root of ansa cervicalis
Internal jugular vein
Common carotid artery

Plate 27.3 Arteries, veins, and nerves of the tongue.

DISSECTION **TIP**

To identify the following muscles, note their course:

- The *genioglossus* muscle runs from the mandible to the tongue.
- The *geniohyoid* runs from the mandible to the hyoid bone.
- The *hyoglossus* runs from the tongue to the hyoid bone.
- The *styloglossus* arises from the styloid process and enters the tongue posteriorly and passes under the palatoglossus to fuse with the hyoglossus muscle.

- ○ **After you identify these muscles, make a small vertical cut near the tip of the tongue, and expose the vertical muscle fibers and intrinsic transverse muscle fibers.**
- ○ **Make another incision in the superficial tissue from the dorsum of the tongue, and expose the intrinsic longitudinal fibers (Fig. 27.23).**

ANATOMY **NOTE**

In some cadavers, you may find some bony outgrowths in the oral cavity the torus palatinus and torus mandibularis. The *torus palatinus* and *torus mandibularis* are variant benign excrescences of the hard palate and mandible, respectively (Fig. 27.24).

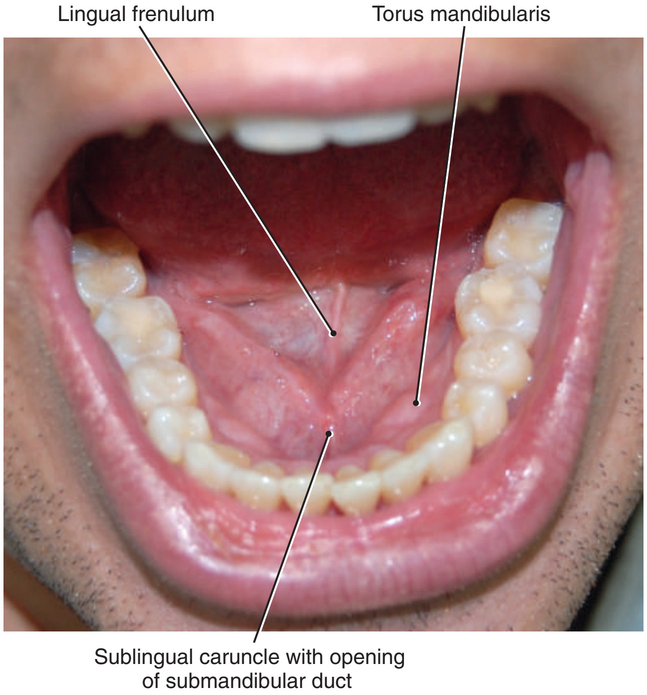

Lingual frenulum
Torus mandibularis
Sublingual caruncle with opening of submandibular duct

Fig. 27.24 Torus mandibularis is a benign, bony outgrowth of the mandible.

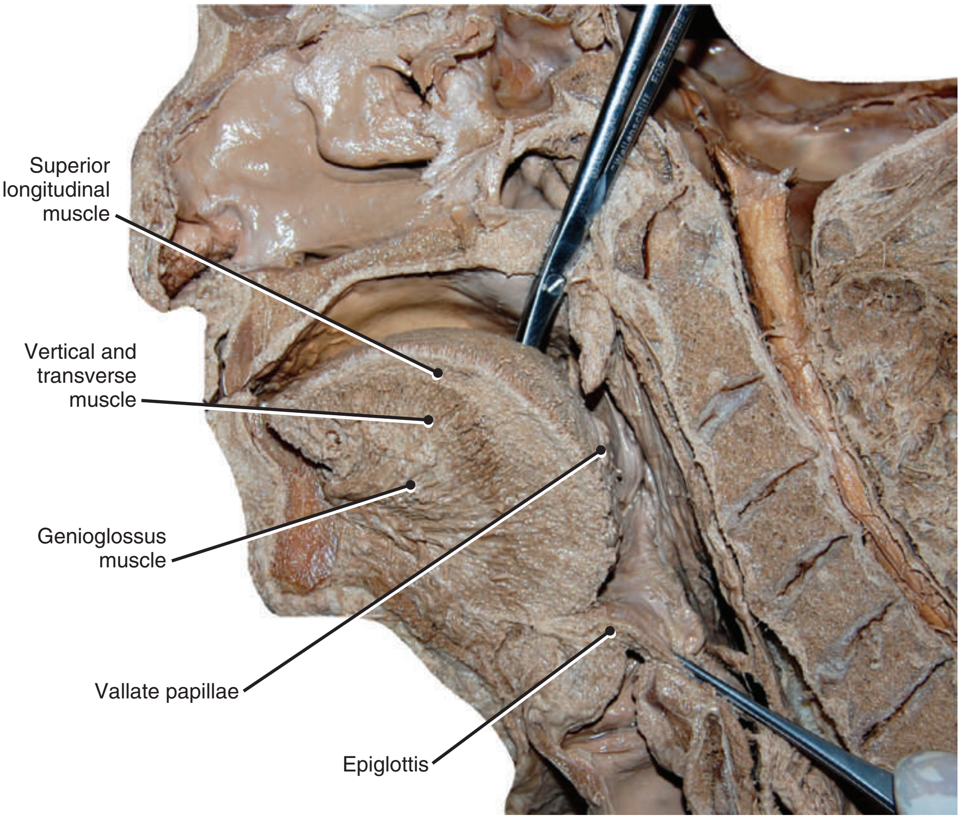

Superior longitudinal muscle
Vertical and transverse muscle
Genioglossus muscle
Vallate papillae
Epiglottis

Fig. 27.23 Midsagittal section of cadaveric head reveals intrinsic muscle of tongue.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Lingual
- ☐ Hypoglossal
- ☐ Nerve to mylohyoid
- ☐ Glossopharyngeal

GANGLION

- ☐ Submandibular

ARTERY

- ☐ Lingual

VEIN

- ☐ Lingual

MUSCLES

- ☐ Digastric
  - ☐ Anterior belly
  - ☐ Posterior belly
- ☐ Mylohyoid
- ☐ Geniohyoid
- ☐ Genioglossus
- ☐ Tongue
  - ☐ Superior longitudinal fibers
  - ☐ Inferior longitudinal fibers
  - ☐ Horizontal fibers
  - ☐ Vertical fibers
  - ☐ Hyoglossus
  - ☐ Styloglossus

BONES

- ☐ Mandible
- ☐ Hyoid
- ☐ Temporal
  - ☐ Styloid process
  - ☐ Mastoid process

SALIVARY GLANDS

- ☐ Submandibular
  - ☐ Superficial and deep lobes
  - ☐ Submandibular duct (Wharton's duct)
- ☐ Sublingual

CHAPTER 28 LARYNX

ATLAS REFERENCES

Netter: 89–93
McMinn: 48–50
Gray's Atlas: 558–562

BEFORE YOU BEGIN

The larynx occupies the space between the epiglottis superiorly and the inferior border of the cricoid cartilage.

INSPECTION

Technique 1

- The inspection begins by examining the larynx in a hemisected head.
- In a hemisected specimen, identify the epiglottis, laryngopharynx, thyroid cartilage, vallecula, uvula, posterior pharyngeal wall, cervical vertebrae, and trachea (Fig. 28.1 and Plate 28.1).
- If the thyroid and cricoid cartilages are not hemisected, complete the hemisection and expose the contents of the larynx using scissors.

DISSECTION TIP

Do not cut directly in the midline of the cricoid and thyroid cartilages. Try to perform the cut as laterally as possible.

- With your fingertips, keep the larynx open, and identify the supraglottic space, or *vestibule,* extending from the epiglottis to the vestibular folds (Fig. 28.2).
- The *ventricle* is the space between the vestibular (false vocal) folds and the vocal (true vocal) folds (Plate 28.2).
- Note the space between the vocal folds, the *rima glottidis* (Fig. 28.3).
- Identify the infraglottic space between the vocal fold and the first tracheal ring.
- Identify the *aryepiglottic fold,* the mucous membrane stretched between the epiglottis to the apex of the arytenoid cartilages.
- With scissors, cut the remaining part of the larynx in the midsagittal plane (see Fig. 28.3).

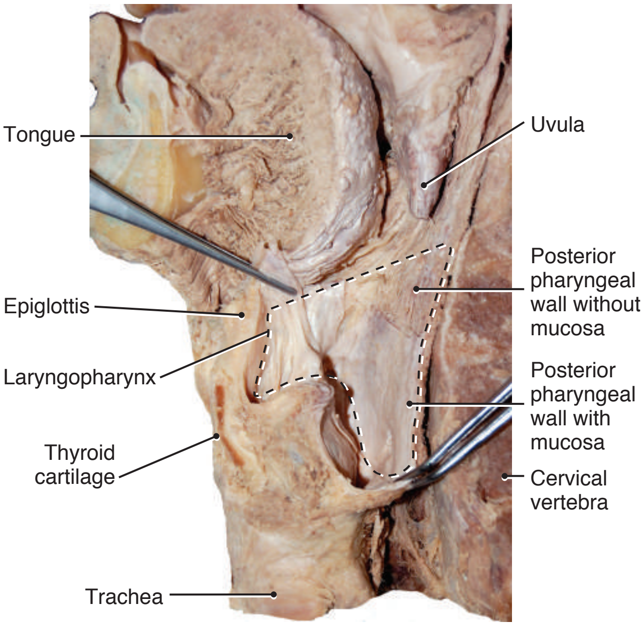

Tongue
Uvula
Posterior pharyngeal wall without mucosa
Epiglottis
Laryngopharynx
Posterior pharyngeal wall with mucosa
Thyroid cartilage
Cervical vertebra
Trachea

Fig. 28.1 Sagittal view of mouth and larynx, revealing tongue, epiglottis, laryngopharynx, thyroid cartilage, vallecula, uvula, posterior pharyngeal wall, cervical vertebrae, and trachea.

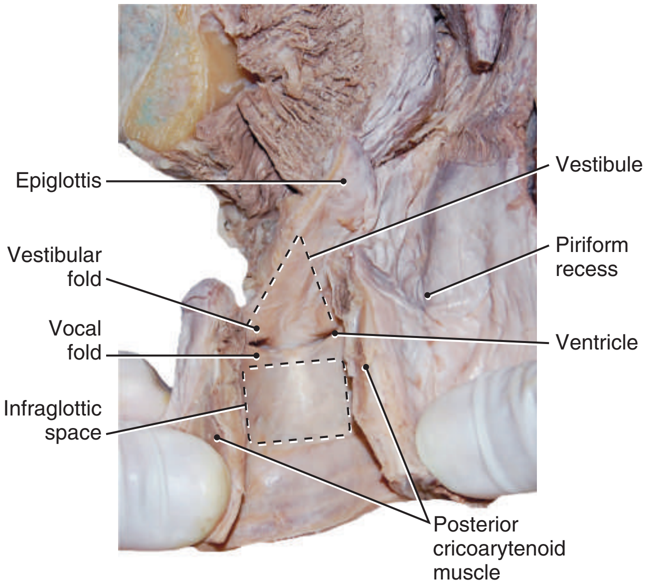
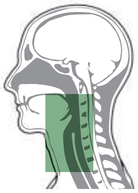

Epiglottis
Vestibule
Vestibular fold
Piriform recess
Vocal fold
Ventricle
Infraglottic space
Posterior cricoarytenoid muscle

Fig. 28.2 Sagittal view of mouth with open posterior view of larynx, highlighting epiglottis, vestibule/laryngeal inlet, vocal fold, vestibular fold, ventricle, posterior cricoarytenoid muscle, and piriform recess.



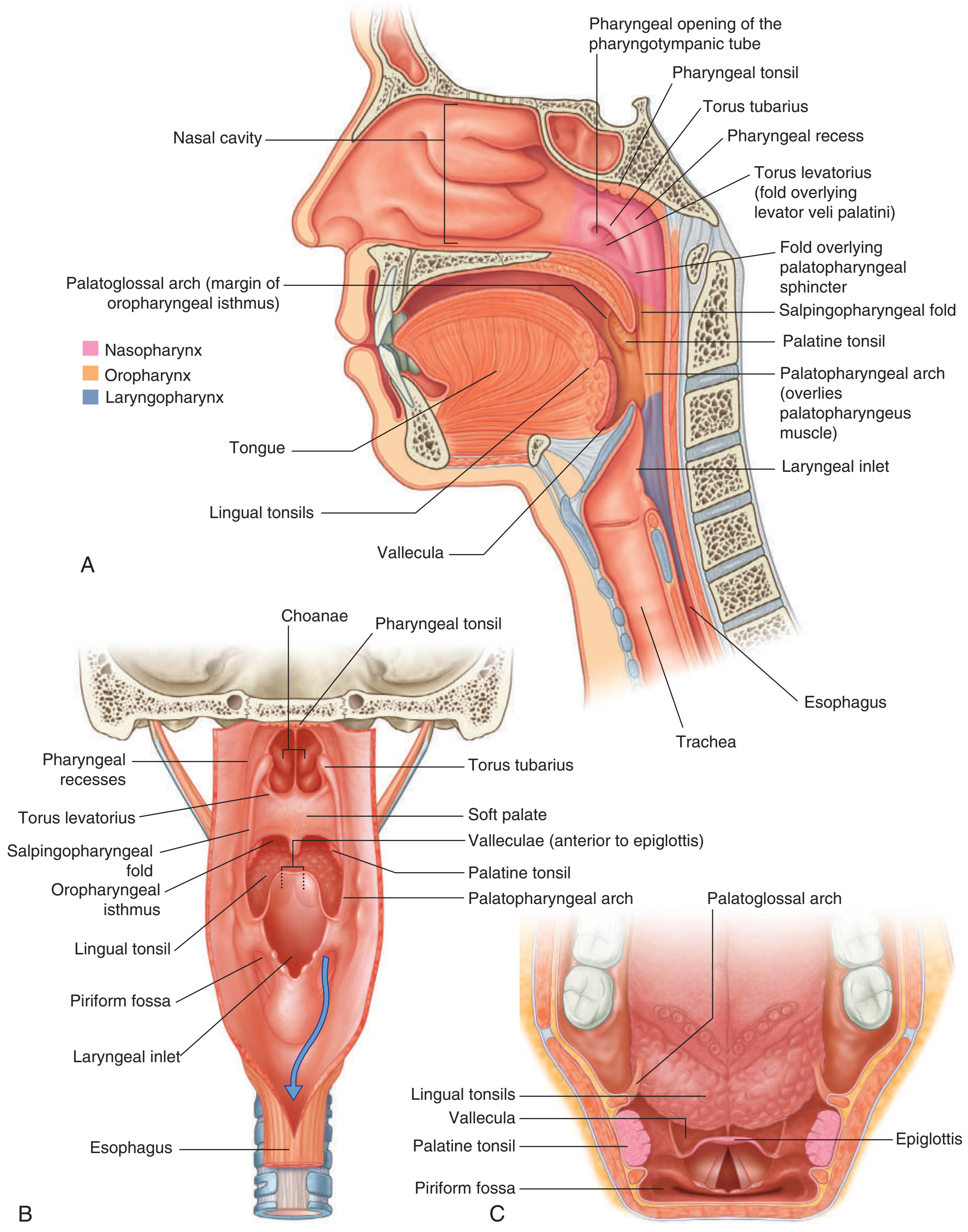

Pharyngeal opening of the pharyngotympanic tube
Pharyngeal tonsil
Torus tubarius
Pharyngeal recess
Torus levatorius (fold overlying levator veli palatini)
Nasal cavity
Fold overlying palatopharyngeal sphincter
Salpingopharyngeal fold
Palatoglossal arch (margin of oropharyngeal isthmus)
Palatine tonsil
Nasopharynx
Oropharynx
Laryngopharynx
Palatopharyngeal arch (overlies palatopharyngeus muscle)
Tongue
Laryngeal inlet
Lingual tonsils
Vallecula
A
Esophagus
Trachea
Choanae
Pharyngeal tonsil
Pharyngeal recesses
Torus tubarius
Torus levatorius
Soft palate
Salpingopharyngeal fold
Valleculae (anterior to epiglottis)
Oropharyngeal isthmus
Palatine tonsil
Palatopharyngeal arch
Palatoglossal arch
Lingual tonsil
Piriform fossa
Laryngeal inlet
Lingual tonsils
Vallecula
Esophagus
Palatine tonsil
Epiglottis
Piriform fossa
B
C

Plate 28.1 A lateral view of a hemisected specimen featuring structures in the nasal cavity, oral cavity, larynx and pharynx.

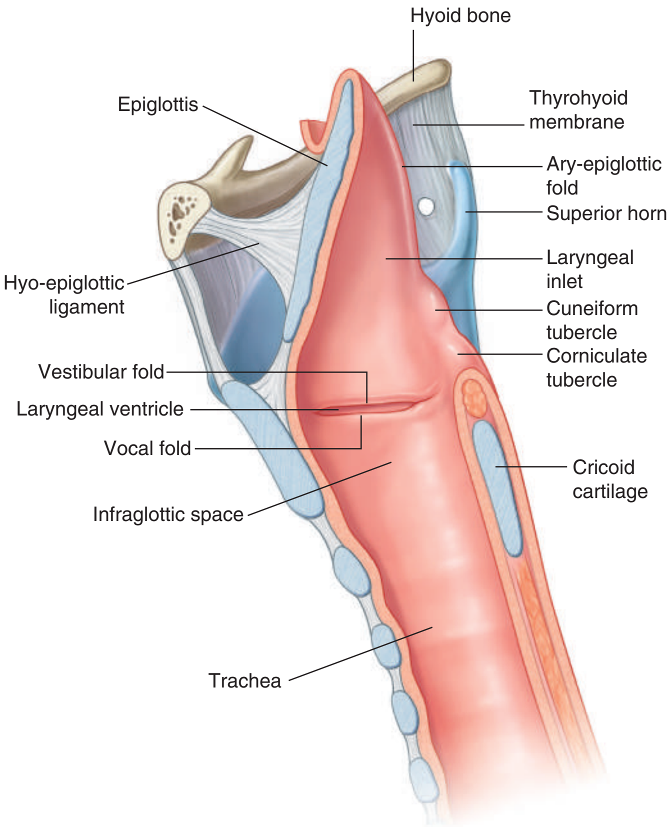

Hyoid bone
Epiglottis
Thyrohyoid membrane
Ary-epiglottic fold
Superior horn
Hyo-epiglottic ligament
Laryngeal inlet
Cuneiform tubercle
Corniculate tubercle
Vestibular fold
Laryngeal ventricle
Vocal fold
Cricoid cartilage
Infraglottic space
Trachea

Plate 28.2 A sagittal section through laryngeal cavity showing vocal and vestibular folds.

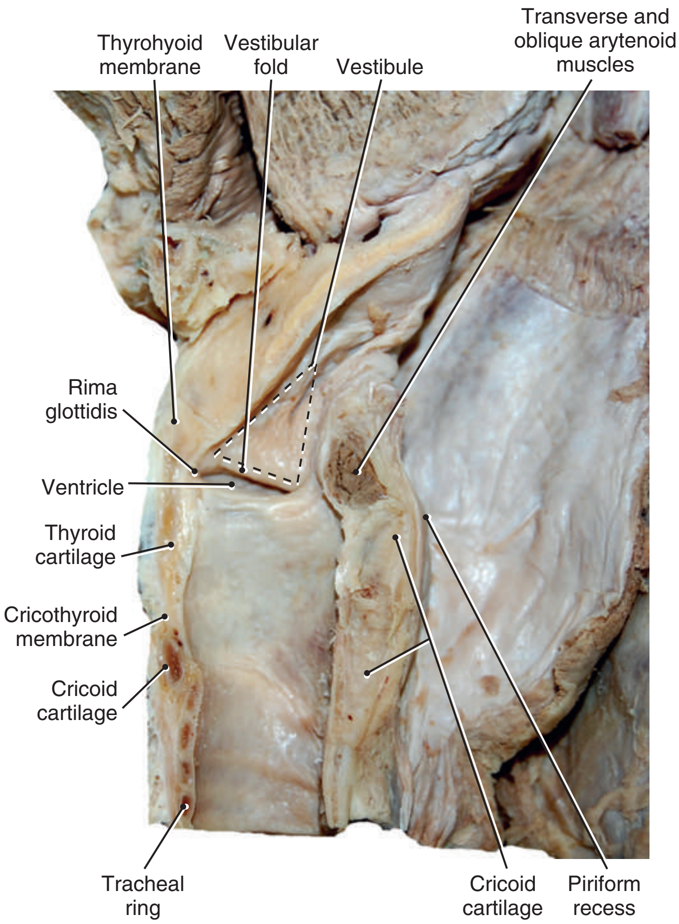

Thyrohyoid membrane
Vestibular fold
Vestibule
Transverse and oblique arytenoid muscles
Rima glottidis
Ventricle
Thyroid cartilage
Cricothyroid membrane
Cricoid cartilage
Tracheal ring
Cricoid cartilage
Piriform recess

Fig. 28.4 Sagittal view with vestibule/laryngeal inlet, vestibular fold, vocal fold, ventricle, thyroid and cricoid cartilages, tracheal ring, transverse arytenoid muscle, and piriform recess.

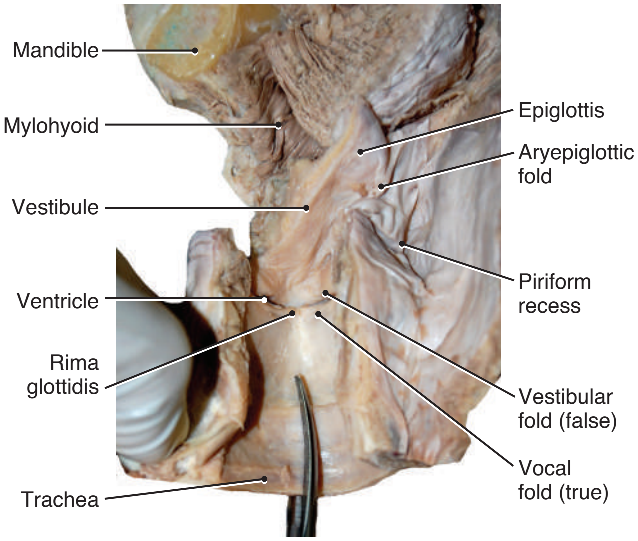

Mandible
Mylohyoid
Vestibule
Ventricle
Rima glottidis
Trachea
Epiglottis
Aryepiglottic fold
Piriform recess
Vestibular fold (false)
Vocal fold (true)

Fig. 28.3 Sagittal oral view with open posterior laryngeal view, revealing mandible, mylohyoid muscle, epiglottis, vestibule/laryngeal inlet, piriform recess, vestibular fold, vocal fold, ventricle, and trachea.

- Identify the epiglottis and the thyroid and cricoid cartilages (Fig. 28.4).
- Note the thyroid cartilage and its attachment to the hyoid bone through the thyrohyoid membrane.
- Identify the attachment of the thyroid cartilage to the cricoid cartilage by the cricothyroid membrane.
- Palpate the arytenoid cartilages (Fig. 28.5) and at their free edge in the aryepiglottic fold, feel the corniculate and cuneiform cartilages.
- Palpate the cricoid cartilage and make a midline incision along its posterior surface through the mucous membrane exposing the posterior cricoarytenoid muscle (see Fig. 28.5).
- Superior to the posterior cricoarytenoid muscle, identify the transverse and oblique arytenoid muscles (Figs. 28.6 and 28.7).
- Reflect the mucous membrane over the aryepiglottic fold, and expose the corniculate and cuneiform cartilages (see Fig. 28.7).

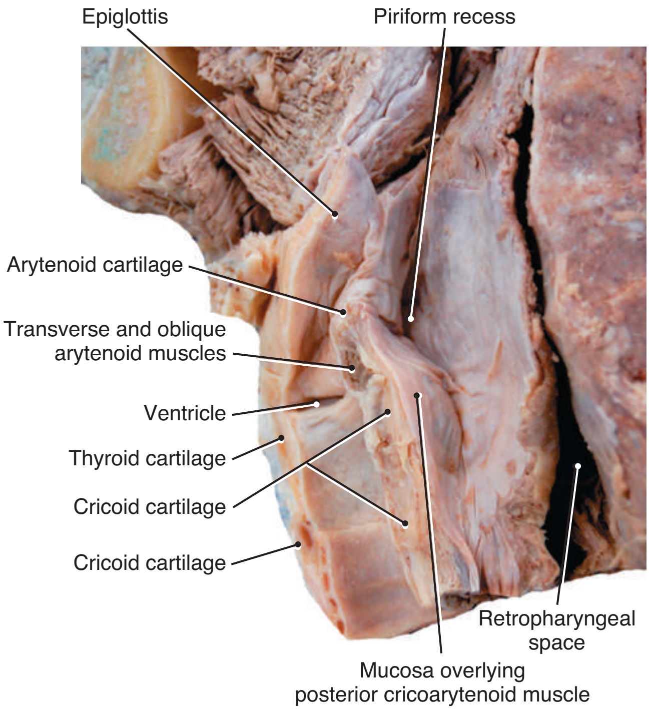

Epiglottis
Piriform recess
Arytenoid cartilage
Transverse and oblique arytenoid muscles
Ventricle
Thyroid cartilage
Cricoid cartilage
Cricoid cartilage
Retropharyngeal space
Mucosa overlying posterior cricoarytenoid muscle

Fig. 28.5 Sagittal view of mouth and larynx with posterior wall of pharynx reflected from cervical vertebrae, revealing epiglottis, transverse arytenoid muscle, ventricle, thyroid cartilage, anterior and posterior regions of cricoid cartilage, posterior cricoarytenoid mucosa, retropharyngeal space, and piriform recess.

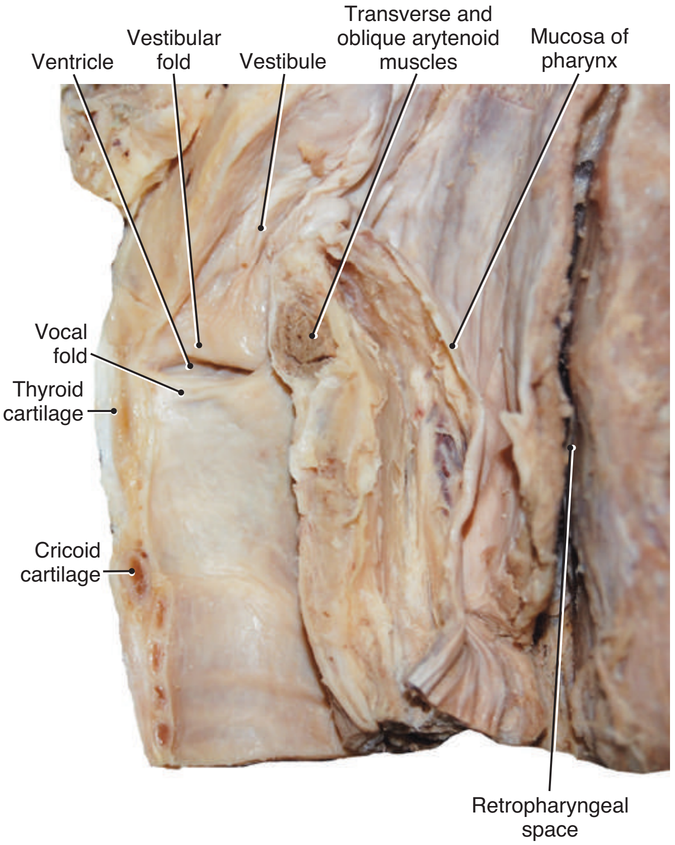
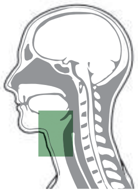

Ventricle
Vestibular fold
Vestibule
Transverse and oblique arytenoid muscles
Mucosa of pharynx
Vocal fold
Thyroid cartilage
Cricoid cartilage
Retropharyngeal space

Fig. 28.6 Sagittal view of laryngeal region, revealing vestibule/laryngeal inlet, arytenoid muscle, vestibular fold, vocal fold, ventricle, cricoid cartilage, thyroid cartilage, mucosa of the pharynx, and retropharyngeal space.



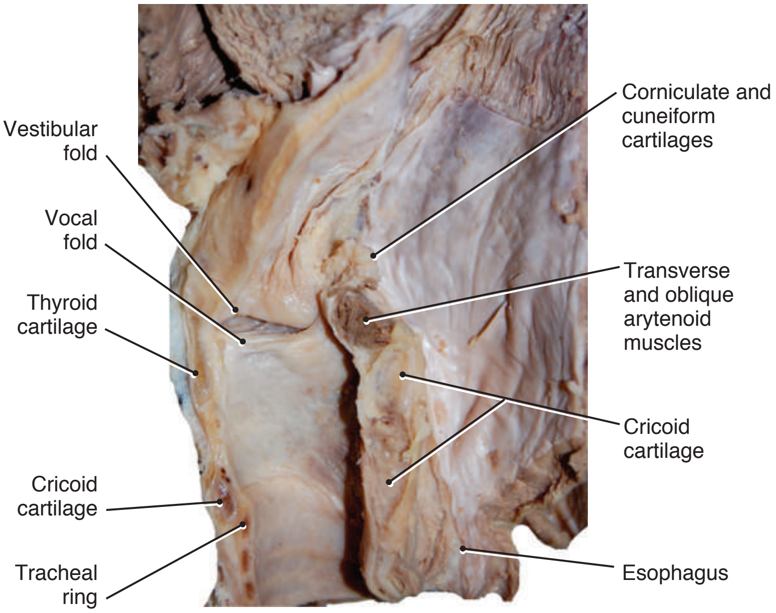
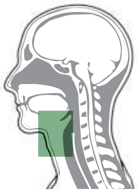

Vestibular fold
Vocal fold
Thyroid cartilage
Cricoid cartilage
Tracheal ring
Corniculate and cuneiform cartilages
Transverse and oblique arytenoid muscles
Cricoid cartilage
Esophagus

Fig. 28.7 Sagittal view of laryngeal region, highlighting corniculate and cuneiform cartilages, pharyngeal mucosa, and esophagus.



INSPECTION
Technique 2

- Another technique for exposing the structures of the larynx is to remove the laryngopharynx and larynx en bloc from the cadaver and examine it.
- Remove the laryngopharynx en bloc from the cadaver, and identify the aryepiglottic fold, piriform recess, and epiglottis (Fig. 28.8).
- Palpate the greater horns (cornu) of the hyoid bone and thyroid cartilage, and remove the soft tissues around the larynx (Fig. 28.9).
- Just inferior to the greater cornu of the hyoid bone, notice the internal branch of superior laryngeal nerve penetrating the thyrohyoid membrane (Fig. 28.10).
- Reflect the mucosa over the posterior portion of the cricoid cartilage, and expose the posterior cricoarytenoid muscle (Fig. 28.11).

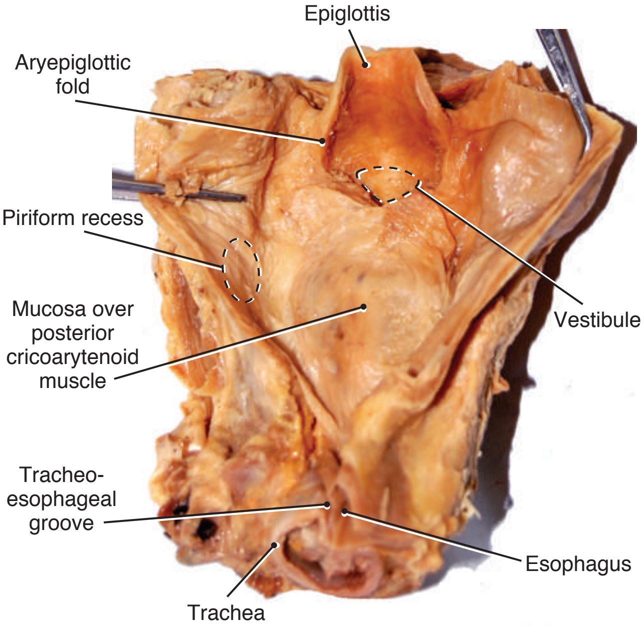

Epiglottis
Aryepiglottic fold
Piriform recess
Mucosa over posterior cricoarytenoid muscle
Vestibule
Tracheo-esophageal groove
Esophagus
Trachea

Fig. 28.8 Posterior view of larynx with posterior pharyngeal wall reflected from midline, revealing epiglottis, aryepiglottic fold, vestibule/laryngeal inlet, piriform recess, and tracheoesophageal groove.

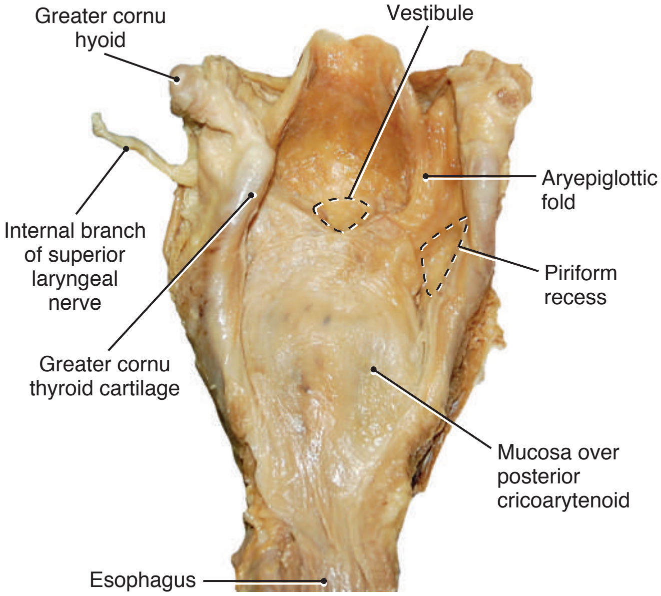

Greater cornu hyoid
Vestibule
Aryepiglottic fold
Internal branch of superior laryngeal nerve
Piriform recess
Greater cornu thyroid cartilage
Mucosa over posterior cricoarytenoid
Esophagus

Fig. 28.10 Posterior view of larynx with posterior pharyngeal wall reflected, revealing vestibule/laryngeal inlet, greater cornu of hyoid and thyroid cartilage, and internal branch of superior laryngeal nerve.

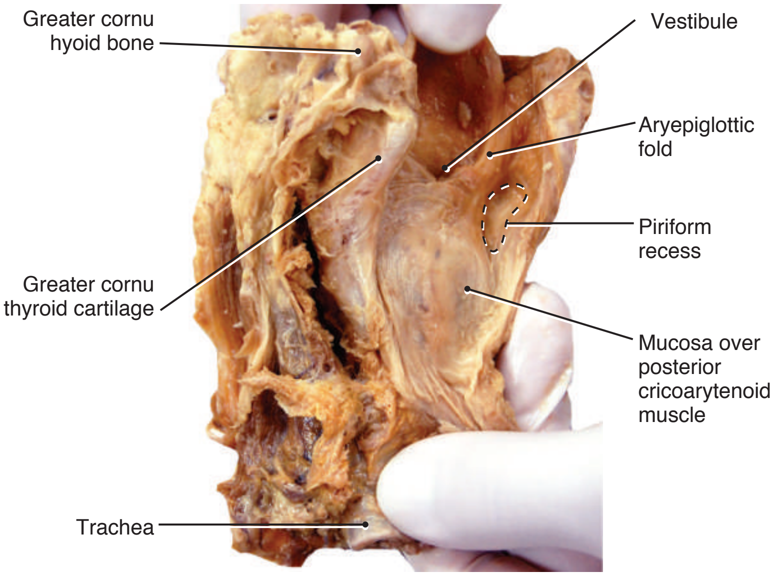

Greater cornu hyoid bone
Vestibule
Aryepiglottic fold
Piriform recess
Greater cornu thyroid cartilage
Mucosa over posterior cricoarytenoid muscle
Trachea

Fig. 28.9 Posterior view of larynx with posterior pharyngeal wall reflected from midline, highlighting horns (cornua) of hyoid and thyroid cartilage, mucosa over posterior cricoarytenoid muscle, aryepiglottic fold, and piriform recess.

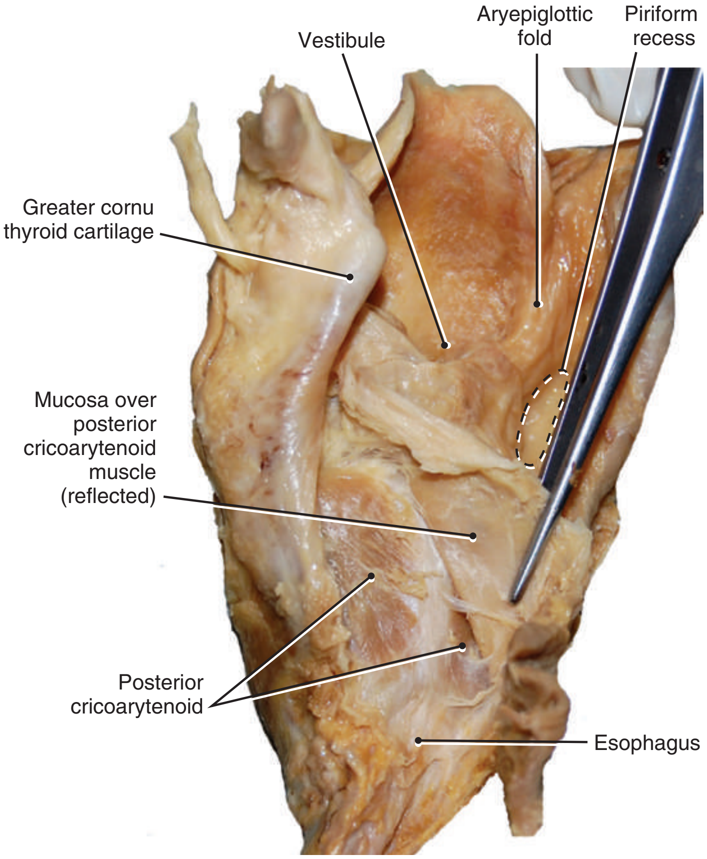

Vestibule
Aryepiglottic fold
Piriform recess
Greater cornu thyroid cartilage
Mucosa over posterior cricoarytenoid muscle (reflected)
Posterior cricoarytenoid
Esophagus

Fig. 28.11 Posterior view of larynx with pharyngeal wall cut from midline, revealing vestibule/laryngeal inlet, greater cornu of thyroid cartilage, posterior cricoarytenoid, esophagus, mucosa over posterior cricoarytenoid muscle, aryepiglottic fold, and piriform recess.

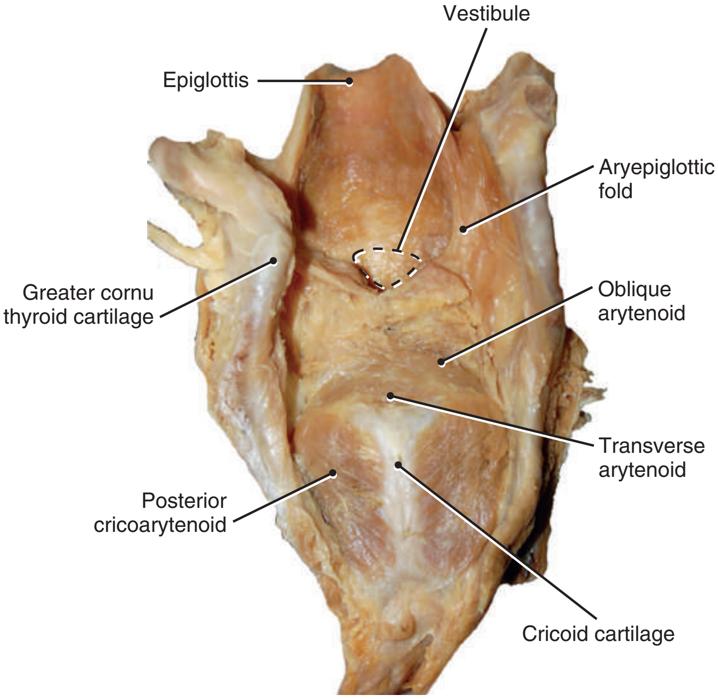

Vestibule
Epiglottis
Aryepiglottic fold
Greater cornu thyroid cartilage
Oblique arytenoid
Transverse arytenoid
Posterior cricoarytenoid
Cricoid cartilage

Fig. 28.12 Posterior view of larynx with posterior pharyngeal wall reflected, revealing epiglottis, vestibule/laryngeal inlet, posterior cricoarytenoid muscle, posterior cricoid cartilage, transverse and oblique arytenoids, and aryepiglottic fold.

- Identify the posterior cricoarytenoid and transverse and oblique arytenoid muscles (Fig. 28.12).
- Make a midline incision through the cricoid cartilage, and identify the vocal and vestibular folds (Fig. 28.13).
- Pull the lateral edges of the cartilages open to fully expose the space between the vocal folds (Fig. 28.14).
- Turn the specimen anteriorly and identify the *cricothyroid muscle.*

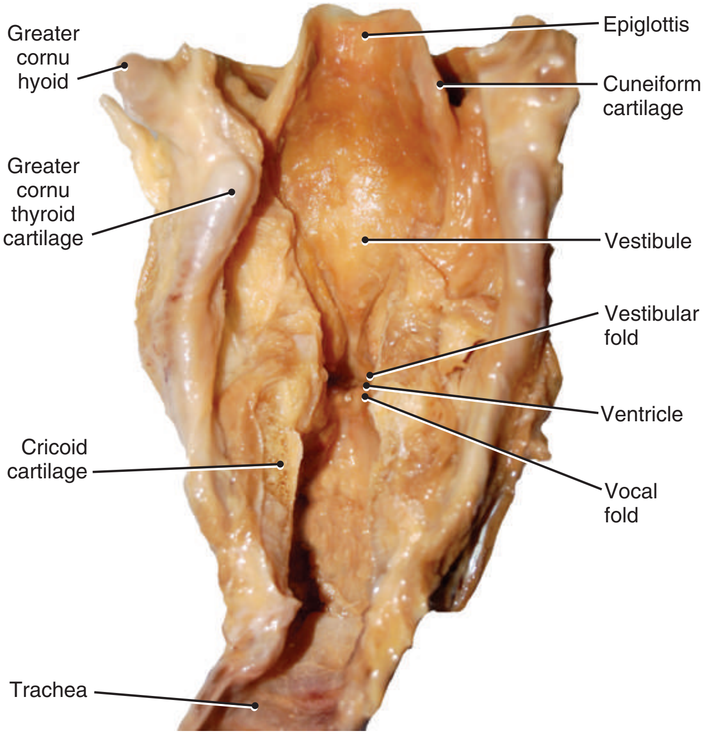

Greater cornu hyoid
Greater cornu thyroid cartilage
Cricoid cartilage
Trachea
Epiglottis
Cuneiform cartilage
Vestibule
Vestibular fold
Ventricle
Vocal fold

Fig. 28.13 Posterior midline view of larynx with cricoid cartilage reflected from midline, highlighting epiglottis, greater cornu (hyoid, thyroid cartilage), vocal and vestibular folds, cuneiform cartilage, ventricle, posterior region of cricoid cartilage, and trachea.

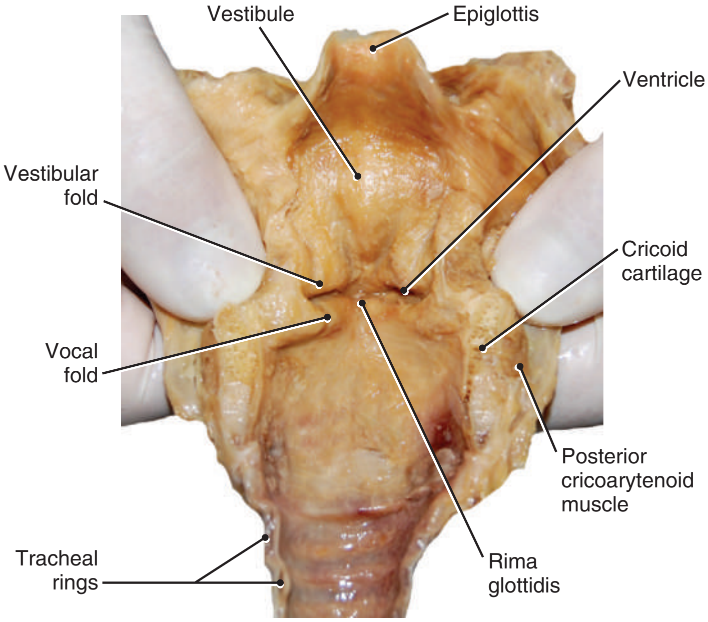

Vestibule
Epiglottis
Ventricle
Vestibular fold
Cricoid cartilage
Vocal fold
Posterior cricoarytenoid muscle
Tracheal rings
Rima glottidis

Fig. 28.14 Posterior view of larynx with cricoid cartilage reflected from midline, revealing epiglottis, vestibule/laryngeal inlet, vestibular fold, vocal fold, ventricle, posterior region of cricoid cartilage, posterior cricoarytenoid muscle, and tracheal rings.

- Reflect the cricothyroid muscle anteriorly from the cricoid cartilage, and identify the median cricothyroid ligament in the midline between the thyroid and cricoid cartilages.
- Identify the *thyroarytenoid muscle* lateral to the transverse and oblique arytenoids, ascending posteriorly from the midline to the arytenoid cartilage.
- Inferior to the thyroarytenoid muscle, a small muscle, the *lateral cricoarytenoid muscle,* runs obliquely superior to the arytenoid cartilage.

DISSECTION **TIP**

If time permits, reflect the thyrohyoid membrane, and trace the course of the internal branch of superior laryngeal nerve to the piriform recess.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

☐ Superior laryngeal
☐ External branch of superior laryngeal
☐ Internal branch of superior laryngeal
☐ Recurrent laryngeal
☐ Inferior laryngeal

ARTERIES

☐ Superior laryngeal

MUSCLES

☐ Uvula
☐ Cricothyroid
☐ Posterior cricoarytenoid
☐ Transverse cricoarytenoid
☐ Oblique cricoarytenoid
☐ Vocalis
☐ Lateral cricoarytenoid
☐ Thyroarytenoid

BONES

☐ Hyoid
    ☐ Greater cornu

CARTILAGES

☐ Epiglottis
☐ Thyroid
    ☐ Greater cornu
☐ Cricoid
☐ Arytenoid
☐ Corniculate
☐ Cuneiform
☐ Tracheal rings

MEMBRANES

☐ Thyrohyoid
☐ Cricothyroid

LIGAMENT

☐ Cricothyroid

SPACES/RECESS/FOLDS

☐ Piriform recess
☐ Vestibule
☐ Vocal folds
☐ Ventricle
☐ Vestibular folds
☐ Aryepiglottic folds
☐ Laryngopharynx

CHAPTER 29 RETROPHARYNGEAL REGION AND PHARYNX

ATLAS REFERENCES

Netter: 75, 76, 79, 80, 86–88, 147, 148
McMinn: 45, 47
Gray's Atlas: 553–555, 565

BEFORE YOU BEGIN

Place the cadaver in the supine position, and identify the following landmarks in the postcraniotomy skull (Fig. 29.1):

- Anterior, middle, and posterior cranial fossae
- Transverse and sigmoid sinuses
- Confluence of sinuses

DISSECTION STEPS

- **With toothed forceps and a scalpel, remove the dura mater from the posterior cranial fossa.**
- **With a mallet and chisel, make an inverted V–shaped cut (*dashed line* in Fig. 29.2) in the posterior cranial fossa (Plate 29.1).**
- **Place the chisel 1 to 2 cm in the front of the foramen magnum at the midportion of the clivus, and make a deep cut.**
- **Continue this cut laterally and posteriorly between the jugular foramen and the hypoglossal canal toward the edge of the occipital bone (Fig. 29.3).**
- **Once the incisions are complete, pull the occipital bone backward to separate it from the skull base.**
- **Use a scalpel to cut the soft tissues between the bone fragments.**
- **Have a laboratory partner keep the head stable by holding it as shown in Fig. 29.4.**

DISSECTION TIP

Be careful in making the separation in the region posterior to the jugular foramen. This is where the carotid sheath emerges, and aggressive dissection can damage its contents. As you pull the posterior cranial fossa backward (Fig. 29.5), place your finger in the opening you created at the clivus and pull backward (Fig. 29.6).

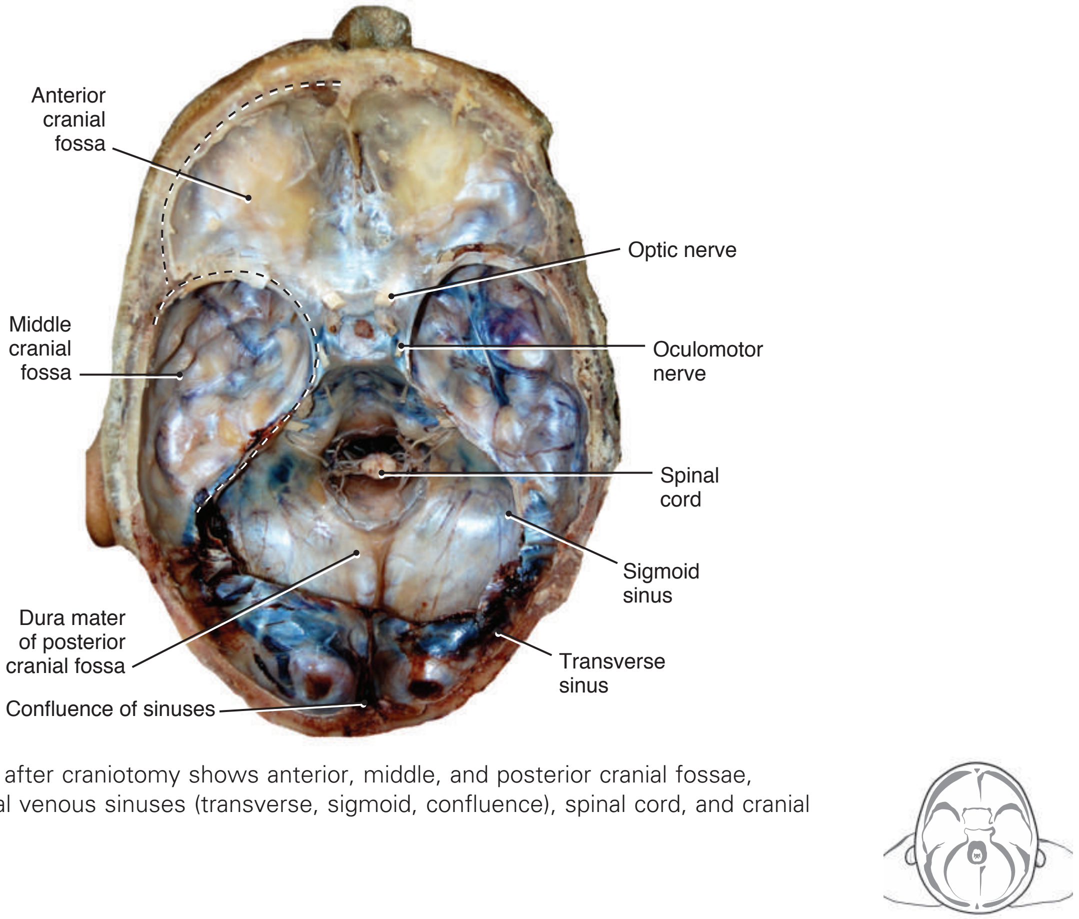


Fig. 29.1 Horizontal section after craniotomy shows anterior, middle, and posterior cranial fossae, highlighting dura mater, dural venous sinuses (transverse, sigmoid, confluence), spinal cord, and cranial nerves (optic, oculomotor).

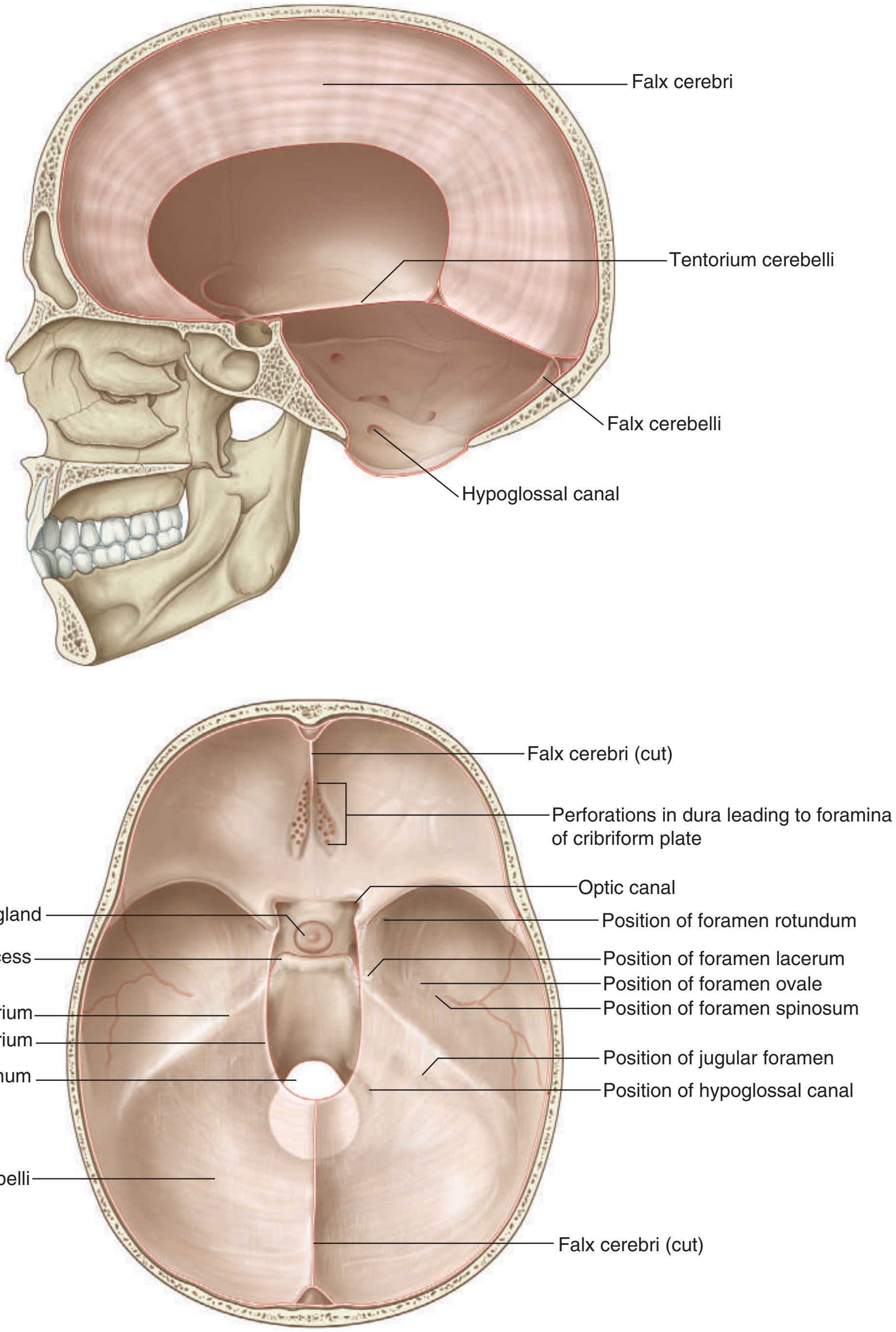

Falx cerebri
Tentorium cerebelli
Falx cerebelli
Hypoglossal canal
Falx cerebri (cut)
Perforations in dura leading to foramina of cribriform plate
Optic canal
Pituitary gland
Position of foramen rotundum
Posterior clinoid process
Position of foramen lacerum
Position of foramen ovale
Attached part of tentorium
Position of foramen spinosum
Free edge of tentorium
Position of jugular foramen
Foramen magnum
Position of hypoglossal canal
Tentorium cerebelli
Falx cerebri (cut)

Plate 29.1 Depiction of cranial fossae, dura matter, and venous sinuses.

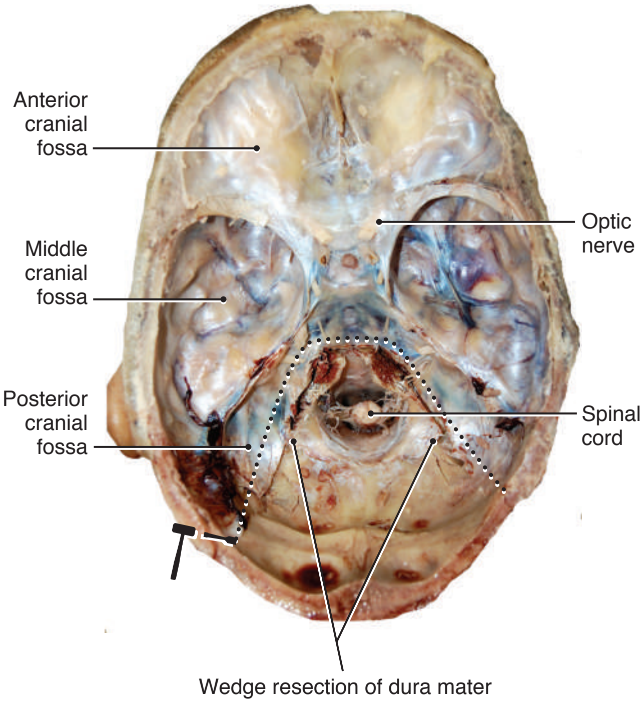

Anterior cranial fossa
Middle cranial fossa
Posterior cranial fossa
Optic nerve
Spinal cord
Wedge resection of dura mater

Fig. 29.2 Postcraniotomy horizontal section reveals anterior, middle, and posterior cranial fossae, with inverted-V–shaped section of dura mater removed from posterior cranial fossa, highlighting dural venous sinuses, spinal cord, and cranial nerves.

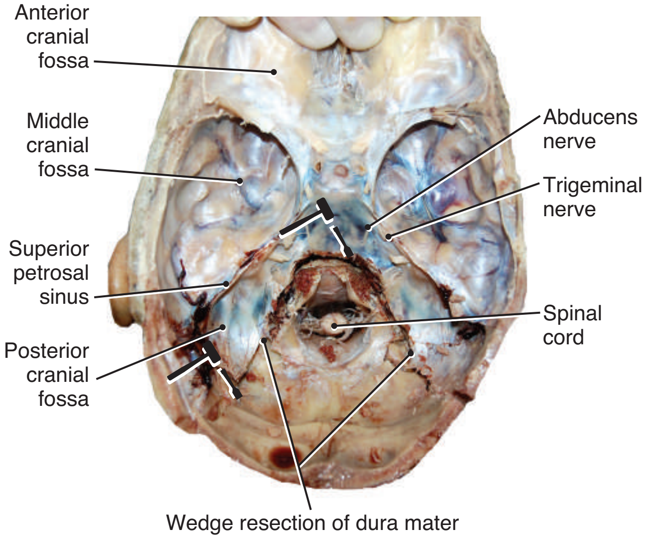

Anterior cranial fossa
Middle cranial fossa
Superior petrosal sinus
Posterior cranial fossa
Abducens nerve
Trigeminal nerve
Spinal cord
Wedge resection of dura mater

Fig. 29.3 Horizontal section after craniotomy reveals anterior, middle, and posterior cranial fossae, with section of dura mater removed from posterior cranial fossae, and a cut from clivus to occipital bone, highlighting dura mater, dural venous sinuses (superior petrosal), spinal cord, and cranial nerves (abducens, trigeminal).

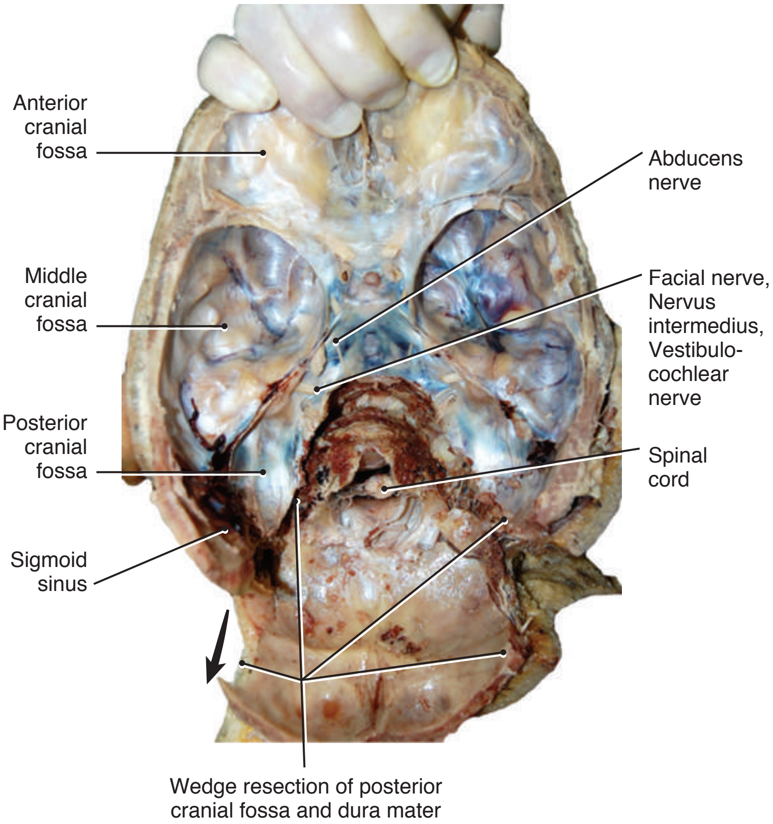

Anterior cranial fossa
Middle cranial fossa
Posterior cranial fossa
Sigmoid sinus
Abducens nerve
Facial nerve, Nervus intermedius, Vestibulocochlear nerve
Spinal cord
Wedge resection of posterior cranial fossa and dura mater

Fig. 29.4 Postcraniotomy horizontal section reveals anterior, middle, and posterior cranial fossae, with wedge resection from posterior cranial fossa reflected, highlighting dural venous sinuses (sigmoid sinus), spinal cord, and cranial nerves (abducens, facial, nervus intermedius, vestibulocochlear).

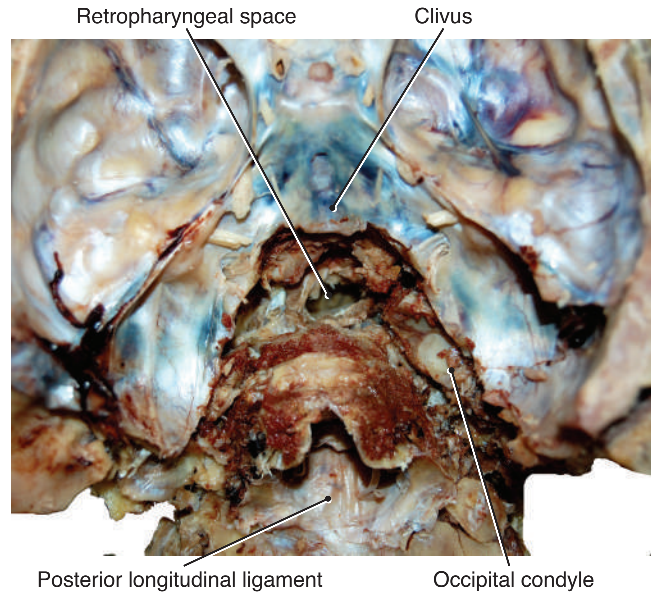
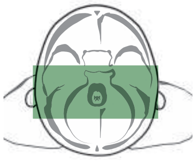

Retropharyngeal space
Clivus
Posterior longitudinal ligament
Occipital condyle

Fig. 29.5 Horizontal section after craniotomy, magnifying clival region of posterior cranial fossa and revealing small opening at retropharyngeal space.



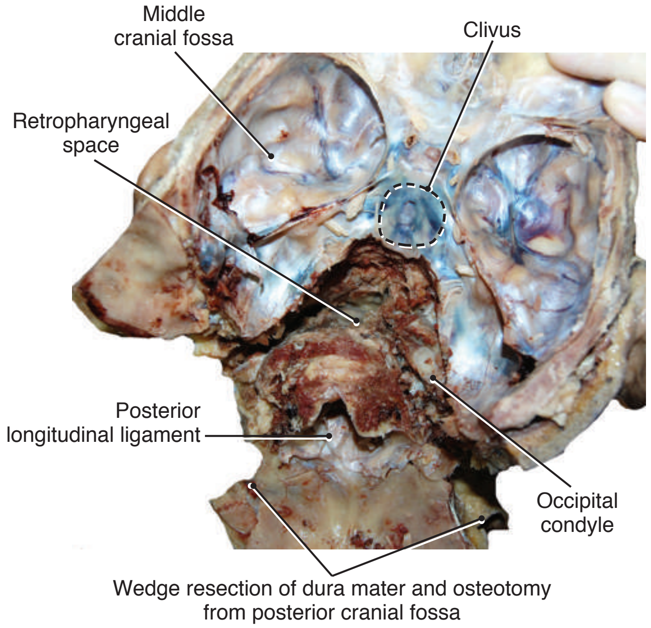

Middle cranial fossa
Clivus
Retropharyngeal space
Posterior longitudinal ligament
Occipital condyle
Wedge resection of dura mater and osteotomy from posterior cranial fossa

Fig. 29.7 Horizontal section after craniotomy of middle and posterior cranial fossae, with wedge osteotomy resection of posterior cranial fossa, revealing a large opening, the *retropharyngeal space.*

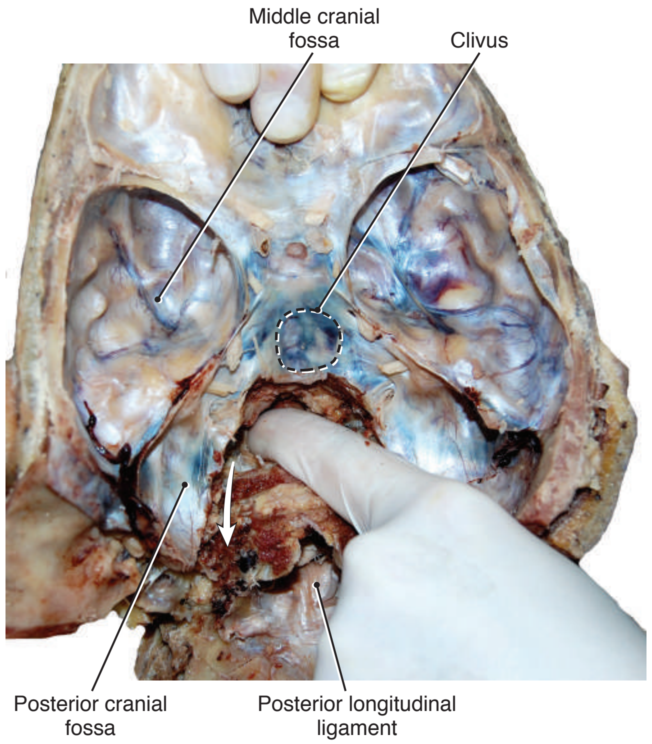

Middle cranial fossa
Clivus
Posterior cranial fossa
Posterior longitudinal ligament

Fig. 29.6 Postcraniotomy horizontal section highlighting anterior, middle, and posterior cranial fossae, with wedge osteotomy resection of the posterior cranial fossa and finger in retropharyngeal space, pulling cranial fossa posteriorly.

- Complete the separation of the posterior cranial fossa and musculature from the retropharyngeal space. Carefully cut any soft tissues obstructing the separation (Fig. 29.7).
- Once the separation is complete, stabilize the head in the upright position, and fully expose the retropharyngeal space (Fig. 29.8).
- Palpate the *pharyngeal tubercle,* which provides attachment to the fibrous raphe (seam) of the pharynx and is the point of attachment for the superior pharyngeal constrictor muscle (Fig. 29.9 and Plate 29.2).
- Identify the sternocleidomastoid muscle laterally.
- Beneath the tubercle, the *buccopharyngeal fascia* invests the constrictor muscles of the pharynx.
- Lateral to this fascia, note a thickened, whitish condensed fascia, the *carotid sheath.*
- With forceps, lift up the carotid sheath and expose its contents (Figs. 29.10 and 29.11).
- Identify and clean the internal jugular vein, common carotid artery, superior cervical ganglion, and vagus nerve (Fig. 29.12).
- Dissect the internal jugular vein, and identify the accessory nerve at its entrance into the sternocleidomastoid muscle (Fig. 29.13).
- Trace the vagus nerve toward the base of the skull, and identify its inferior (nodose) ganglion and the jugular ganglion. The jugular ganglion of the vagus nerve is located superior to the nodose ganglion.

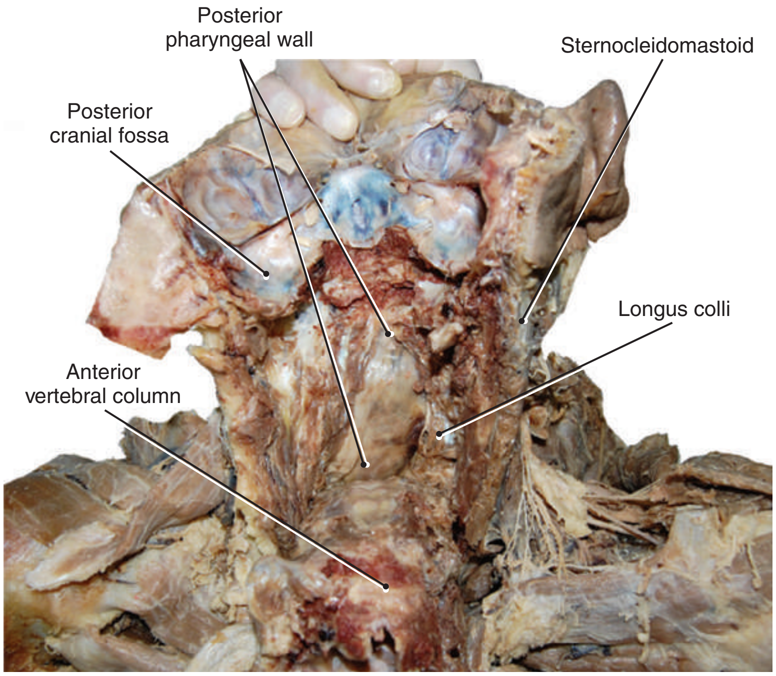

Posterior pharyngeal wall
Sternocleidomastoid
Posterior cranial fossa
Longus colli
Anterior vertebral column

Fig. 29.8 Posterior view of pharynx after retropharyngeal dissection. Anterior view of vertebral column reveals fascia, sternocleidomastoid and longus colli muscles, and posterior cranial fossa.

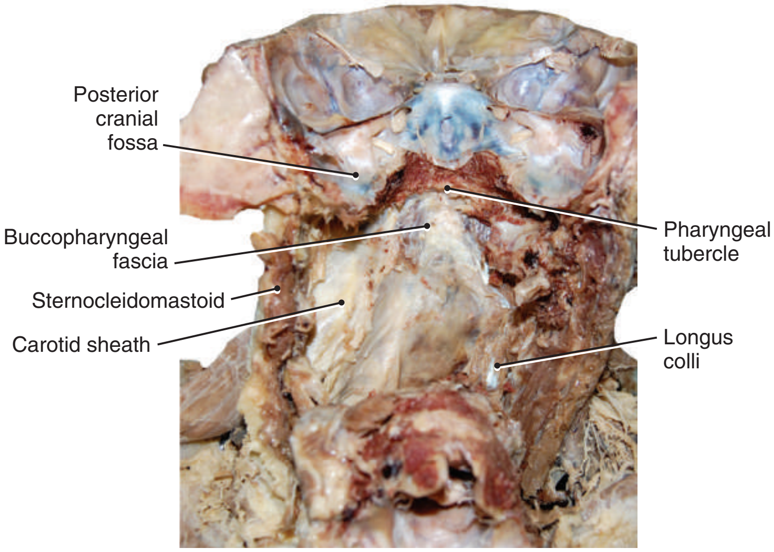
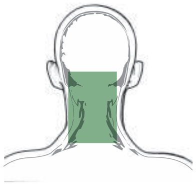

Posterior cranial fossa
Buccopharyngeal fascia
Sternocleidomastoid
Carotid sheath
Pharyngeal tubercle
Longus colli

Fig. 29.9 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, highlighting buccopharyngeal fascia and pharyngeal tubercle.



- **Continue cleaning the carotid sheath and the buccopharyngeal fascia inferiorly (Fig. 29.14), and fully expose its contents (Fig. 29.15).**
- **Identify the superior laryngeal nerve from its origin from the vagus nerve.**
- **Trace the hypoglossal nerve from its emergence from the hypoglossal canal (Fig. 29.16). The *hypoglossal nerve* passes lateral to the internal carotid artery.**
- **Medial to the internal carotid artery, identify the superior laryngeal nerve. Its internal branch travels**

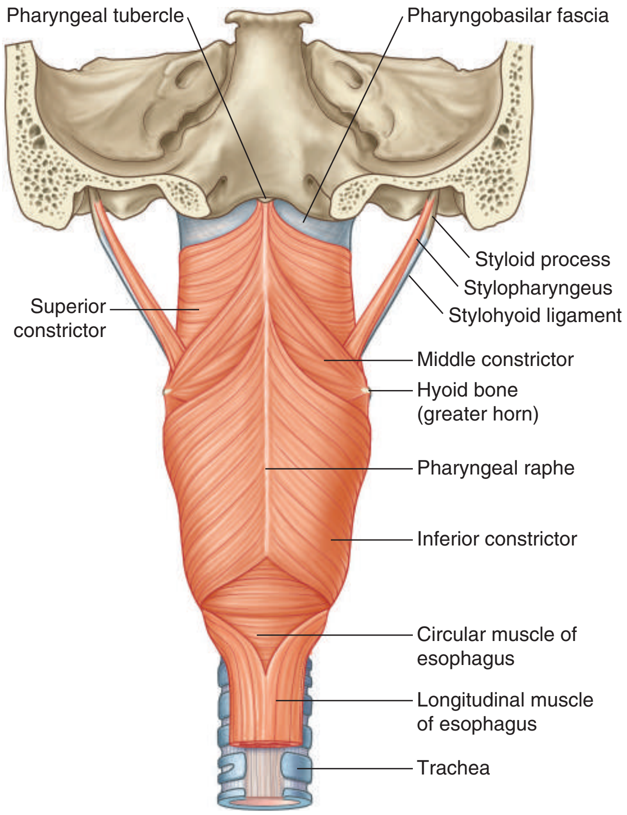

Pharyngeal tubercle
Pharyngobasilar fascia
Styloid process
Stylopharyngeus
Stylohyoid ligament
Superior constrictor
Middle constrictor
Hyoid bone (greater horn)
Pharyngeal raphe
Inferior constrictor
Circular muscle of esophagus
Longitudinal muscle of esophagus
Trachea

Plate 29.2 Depiction of the pharyngeal tubercle and superior, middle, and inferior constrictors (posterior view).

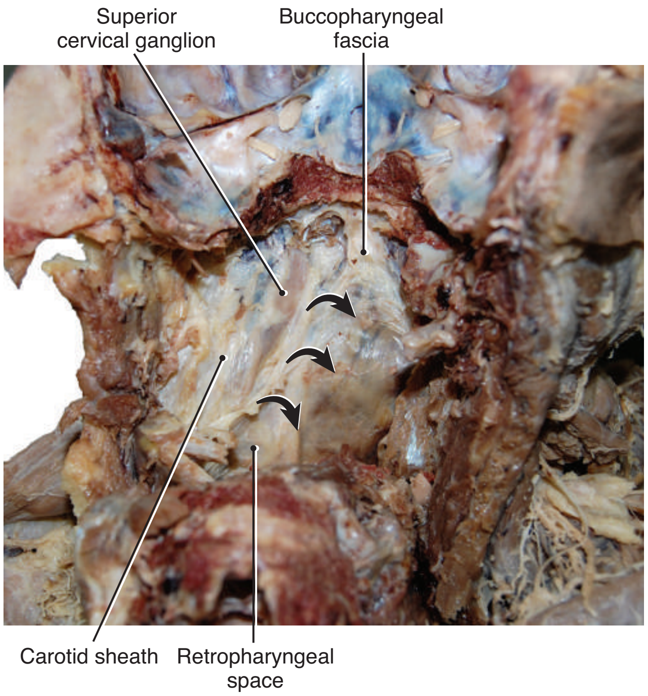
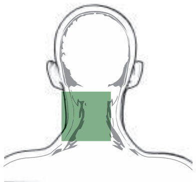

Superior cervical ganglion
Buccopharyngeal fascia
Carotid sheath
Retropharyngeal space

Fig. 29.10 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, revealing buccopharyngeal fascia, sternocleidomastoid muscle, and base of skull.



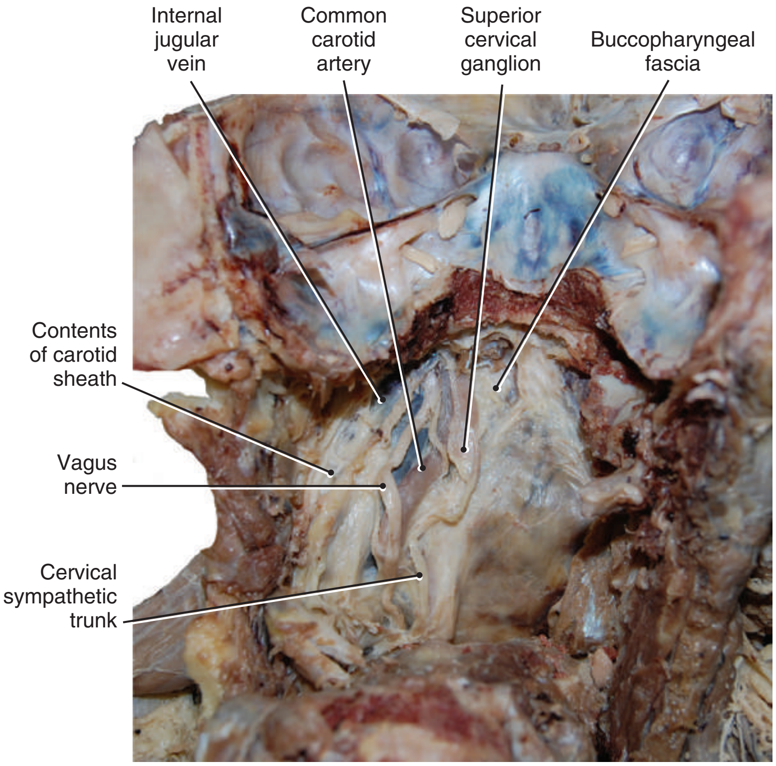
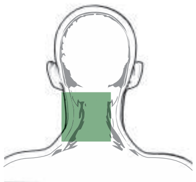

Internal jugular vein
Common carotid artery
Superior cervical ganglion
Buccopharyngeal fascia
Contents of carotid sheath
Vagus nerve
Cervical sympathetic trunk

Fig. 29.11 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, revealing buccopharyngeal fascia, cervical sympathetic trunk, superior cervical ganglion, common carotid artery, internal jugular vein, and vagus nerve.



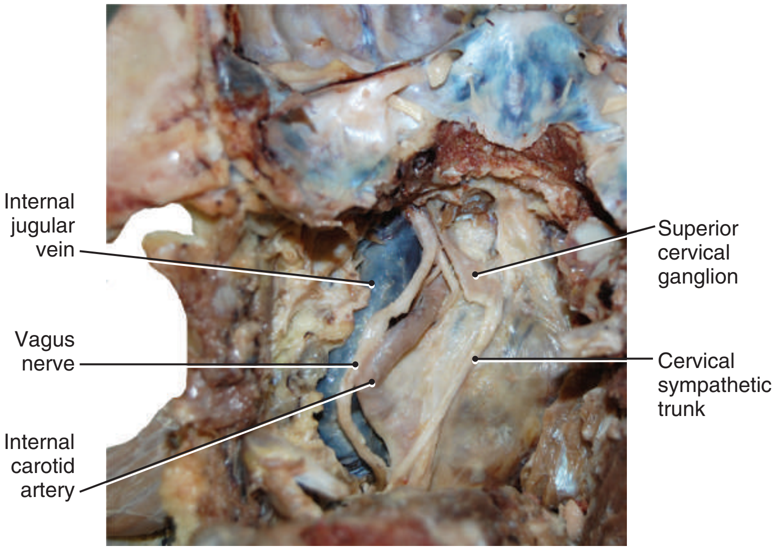
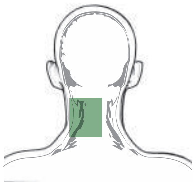

Internal jugular vein
Vagus nerve
Internal carotid artery
Superior cervical ganglion
Cervical sympathetic trunk

Fig. 29.12 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, highlighting contents of carotid sheath (internal jugular vein, common carotid artery, and vagus nerve), as well as superior cervical ganglion and cervical sympathetic trunk.



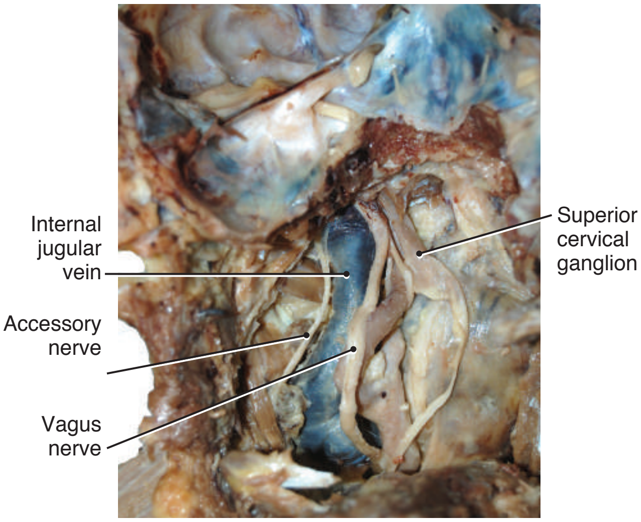
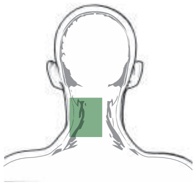

Internal jugular vein
Accessory nerve
Vagus nerve
Superior cervical ganglion

Fig. 29.13 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, revealing internal jugular vein, common carotid artery, inferior vagal ganglion (nodose ganglion), vagus nerve, superior cervical ganglion, and cervical sympathetic trunk.



near the gap between the middle and inferior constrictor muscles of the pharynx or the space between the external carotid artery and cornua of the hyoid bone.

DISSECTION **TIP**

You may encounter multiple lymph nodes around the internal jugular vein. After you identify these, remove them from the field of dissection (Fig. 29.17).

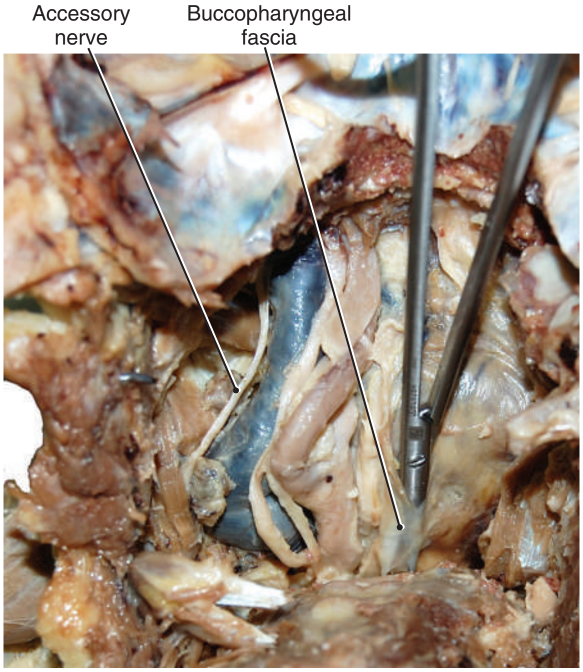
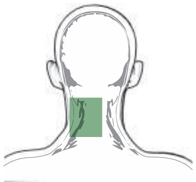

Accessory nerve
Buccopharyngeal fascia

Fig. 29.14 Scissors removing remnants of carotid sheath and buccopharyngeal fascia, further exposing neurovascular structures and superior, middle, and inferior pharyngeal muscles.



- **Lift the internal carotid artery to trace the pathway of the internal laryngeal artery and its division into internal and external branches (see Fig. 29.17).**
- **Identify the superior, middle, and inferior pharyngeal constrictor muscles, and carefully clean the buccopharyngeal fascia and adipose tissue (see Fig. 29.17).**

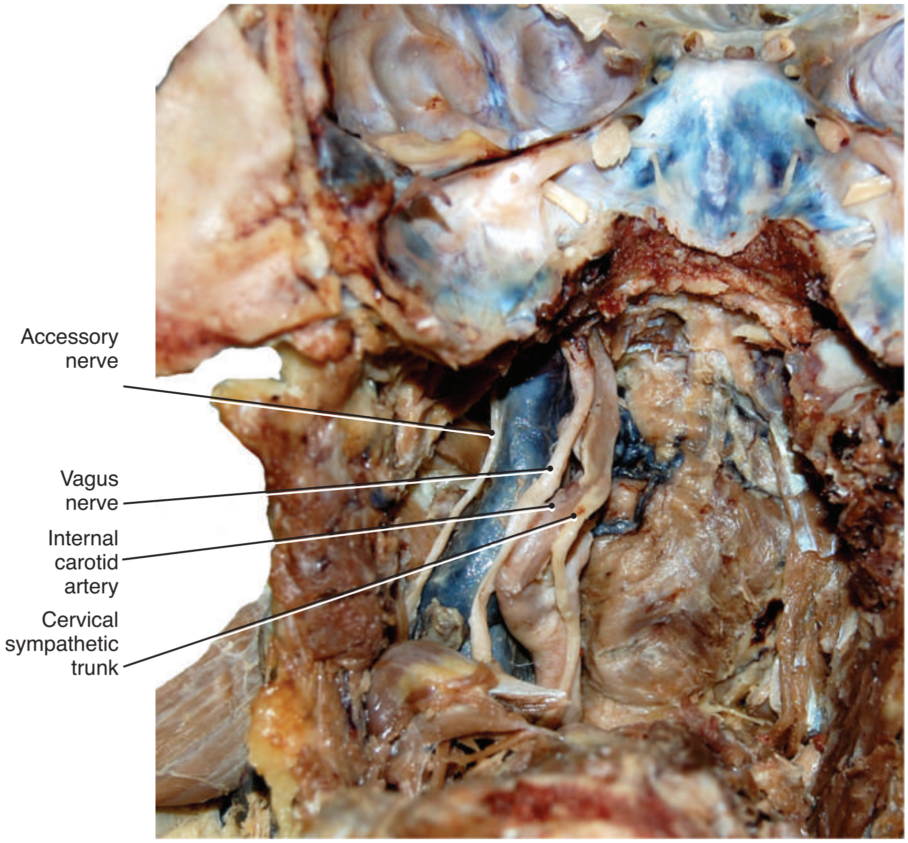
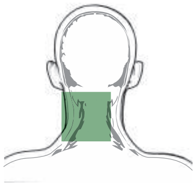

Accessory nerve
Vagus nerve
Internal carotid artery
Cervical sympathetic trunk

Fig. 29.15 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa, highlighting accessory and vagus nerves and cervical sympathetic trunk, as well as internal jugular vein, common carotid artery, inferior (nodose) ganglion, vagus nerve, and superior cervical ganglion.



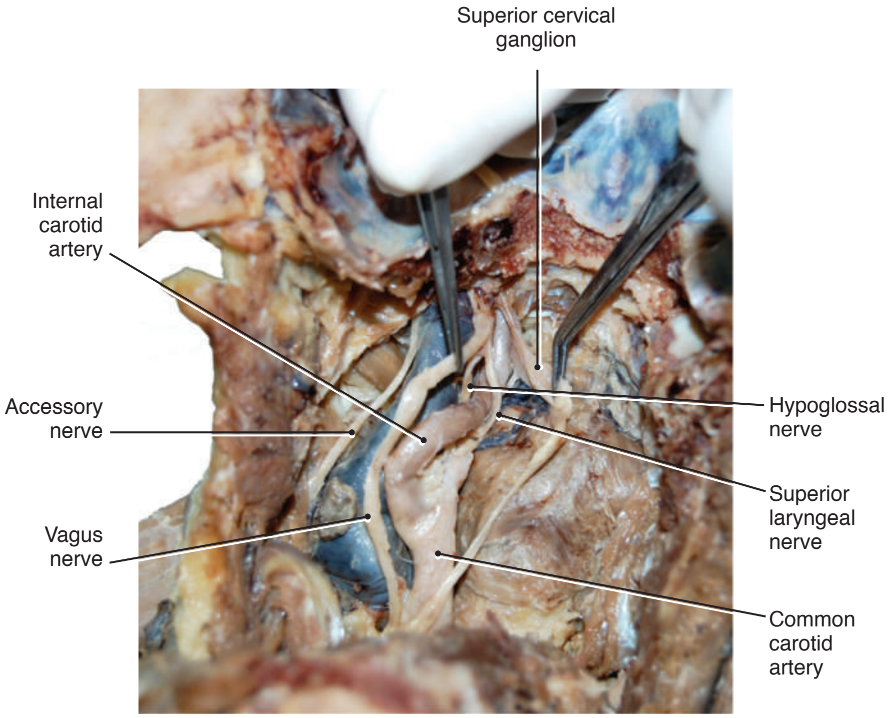
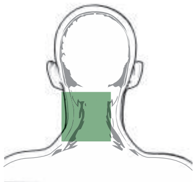
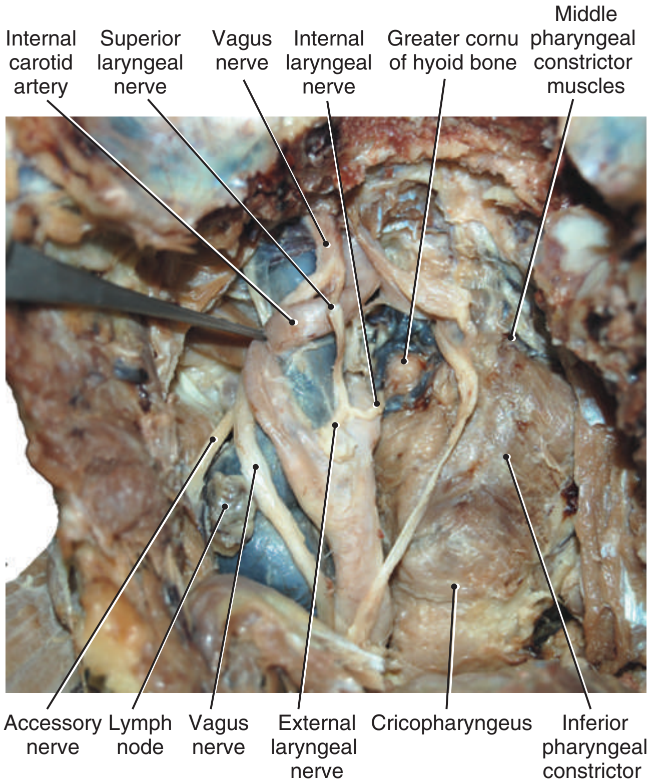

Superior cervical ganglion
Internal carotid artery
Accessory nerve
Vagus nerve
Hypoglossal nerve
Superior laryngeal nerve
Common carotid artery

Fig. 29.16 Forceps retracting superior cervical ganglion medially, further exposing internal jugular vein, common carotid artery, inferior (nodose) ganglion, vagus nerve, superior laryngeal nerve, and hypoglossal nerve.




Internal carotid artery
Superior laryngeal nerve
Vagus nerve
Internal laryngeal nerve
Greater cornu of hyoid bone
Middle pharyngeal constrictor muscles
Accessory nerve
Lymph node
Vagus nerve
External laryngeal nerve
Cricopharyngeus
Inferior pharyngeal constrictor

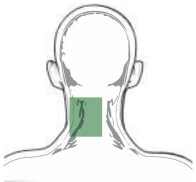
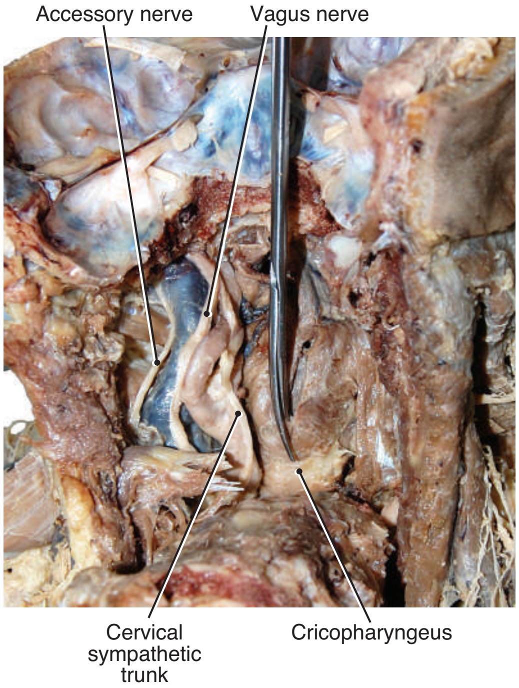


Fig. 29.17 Posterior view of pharynx with wedge osteotomy resection of posterior cranial fossa revealing inferior pharyngeal constrictor (cricopharyngeus). Forceps retracting internal carotid artery laterally, further exposing division of superior laryngeal nerve into internal and external branches.

- Make a midsagittal incision at the midline of the pharyngeal constrictor muscles to expose the internal aspect of the pharynx and to visualize such structures as the cervical sympathetic trunk and the epiglottis (Figs. 29.18 and 29.19).

DISSECTION OF UNDIVIDED SPECIMEN

- A different method of dissection of the retropharyngeal space is through the suboccipital region. In this approach, all the musculature of the back, as well as the cervical vertebrae and spinal cord are removed, exposing the retropharyngeal space (Fig. 29.20 and Plates 29.3 and 29.4).
- The pharyngeal constrictor muscles are especially useful landmarks that can be identified with both dissecting methods as follows:
  - *Superior pharyngeal constrictor:* Identify the gap between the upper border of the superior pharyngeal constrictor muscle and the base of the skull. Clean the pharyngobasilar fascia that occupies this space, and expose the levator veli palatini muscle, auditory tube, and ascending palatine artery (Fig. 29.21).


Accessory nerve
Vagus nerve
Cervical sympathetic trunk
Cricopharyngeus

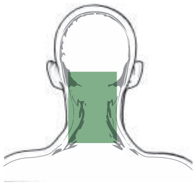
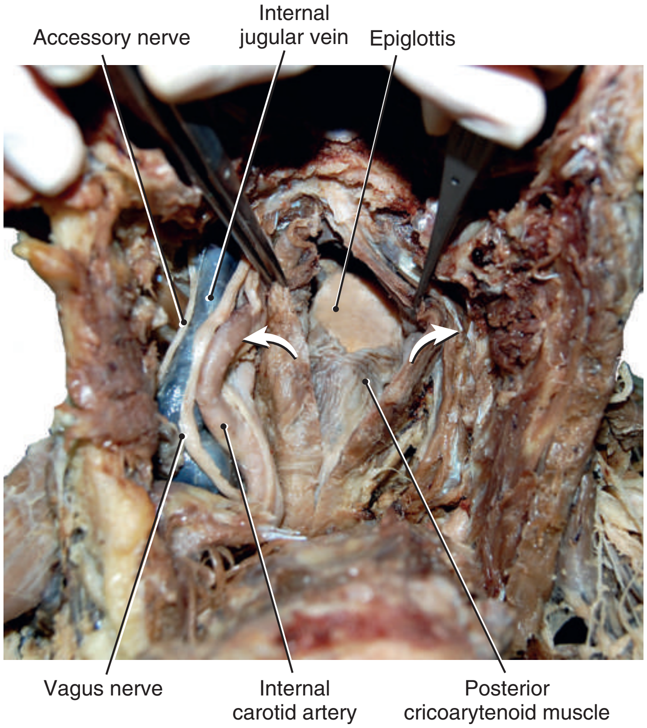


Fig. 29.18 Midsagittal incision at midline of superior middle and inferior pharyngeal constrictors, exposing internal aspect of pharynx.


Accessory nerve
Internal jugular vein
Epiglottis
Vagus nerve
Internal carotid artery
Posterior cricoarytenoid muscle

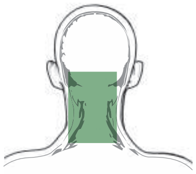


Fig. 29.19 Vertical incision of pharynx with pharyngeal wall reflected, revealing epiglottis and posterior cricoarytenoid muscle.

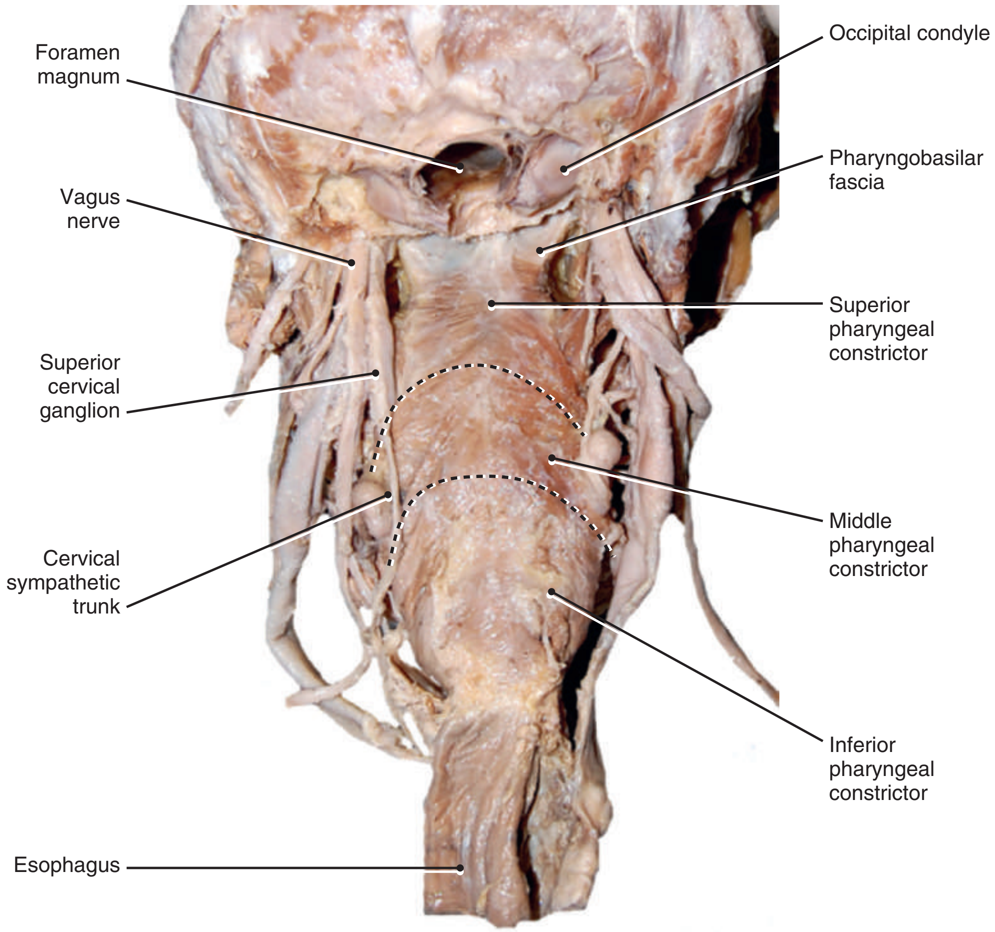
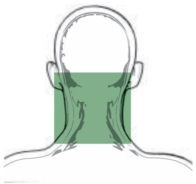

Foramen magnum
Vagus nerve
Superior cervical ganglion
Cervical sympathetic trunk
Esophagus
Occipital condyle
Pharyngobasilar fascia
Superior pharyngeal constrictor
Middle pharyngeal constrictor
Inferior pharyngeal constrictor

Fig. 29.20 Posterior view of pharynx and base of skull, revealing foramen magnum, occipital condyle, pharyngobasilar fascia, and superior, middle, and inferior pharyngeal constrictors, as well as superior cervical ganglion and cervical sympathetic trunk.



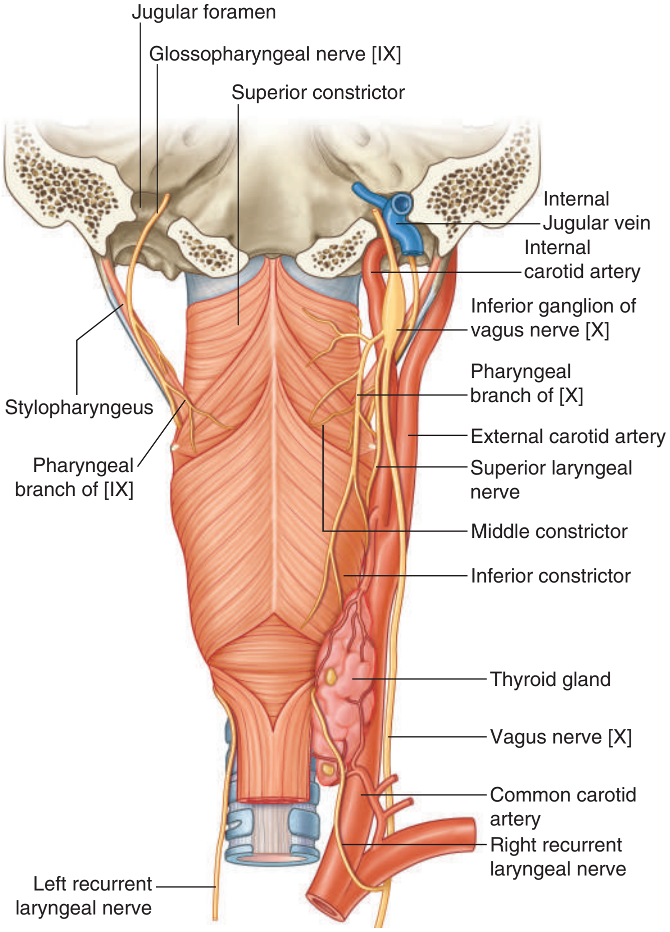

Jugular foramen
Glossopharyngeal nerve [IX]
Superior constrictor
Internal Jugular vein
Internal carotid artery
Inferior ganglion of vagus nerve [X]
Pharyngeal branch of [X]
External carotid artery
Superior laryngeal nerve
Middle constrictor
Inferior constrictor
Thyroid gland
Vagus nerve [X]
Common carotid artery
Right recurrent laryngeal nerve
Stylopharyngeus
Pharyngeal branch of [IX]
Left recurrent laryngeal nerve

Plate 29.3 Posterior view of retropharyngeal space, with vast majority of neurovascular structures and muscles exposed.

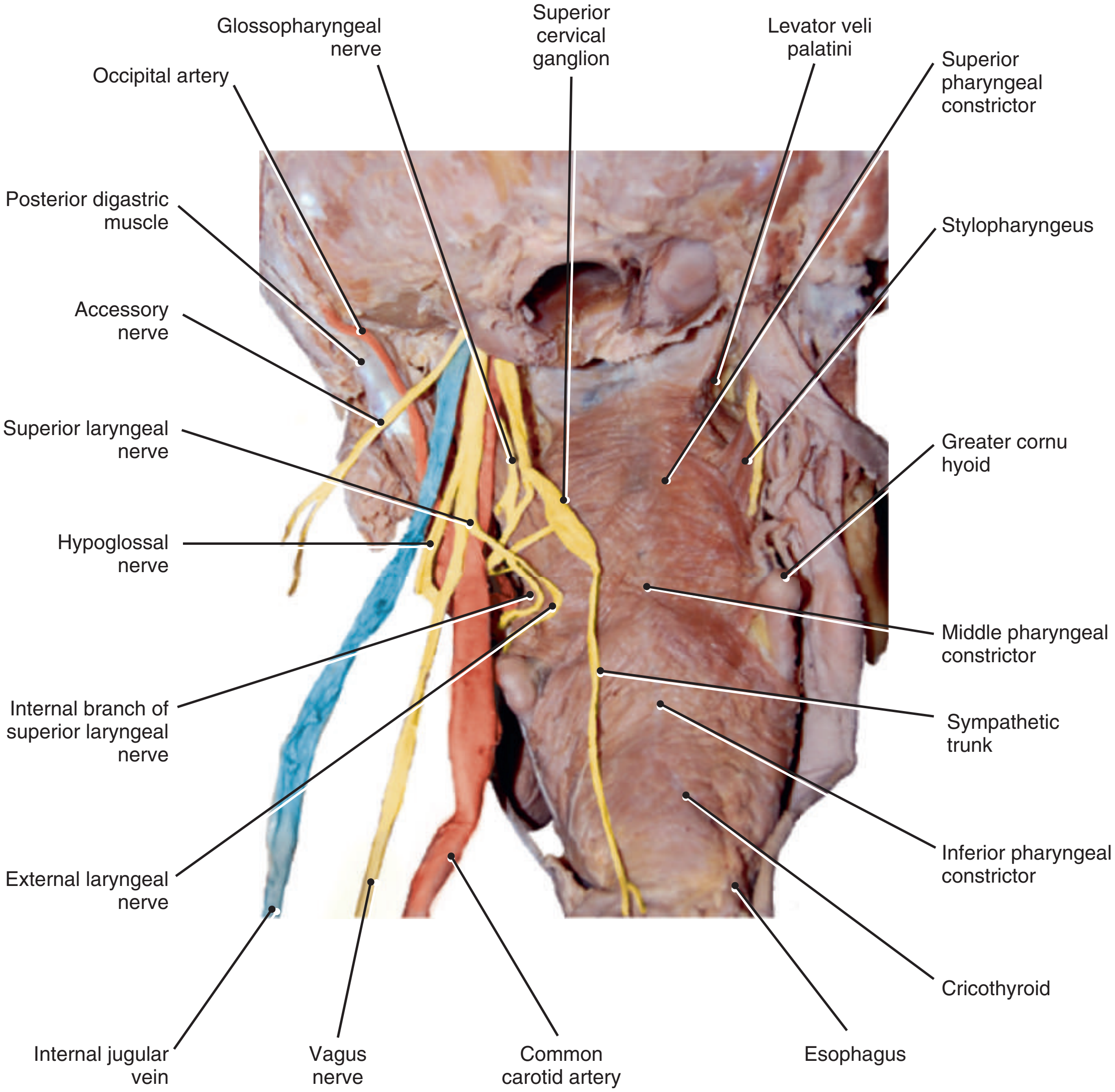
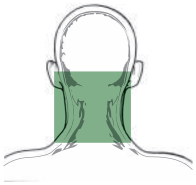

Glossopharyngeal nerve
Superior cervical ganglion
Levator veli palatini
Occipital artery
Superior pharyngeal constrictor
Posterior digastric muscle
Stylopharyngeus
Accessory nerve
Superior laryngeal nerve
Greater cornu hyoid
Hypoglossal nerve
Middle pharyngeal constrictor
Internal branch of superior laryngeal nerve
Sympathetic trunk
Inferior pharyngeal constrictor
External laryngeal nerve
Cricothyroid
Internal jugular vein
Vagus nerve
Common carotid artery
Esophagus

Fig. 29.21 View of retropharyngeal space, with vast majority of neurovascular structures and muscles exposed.



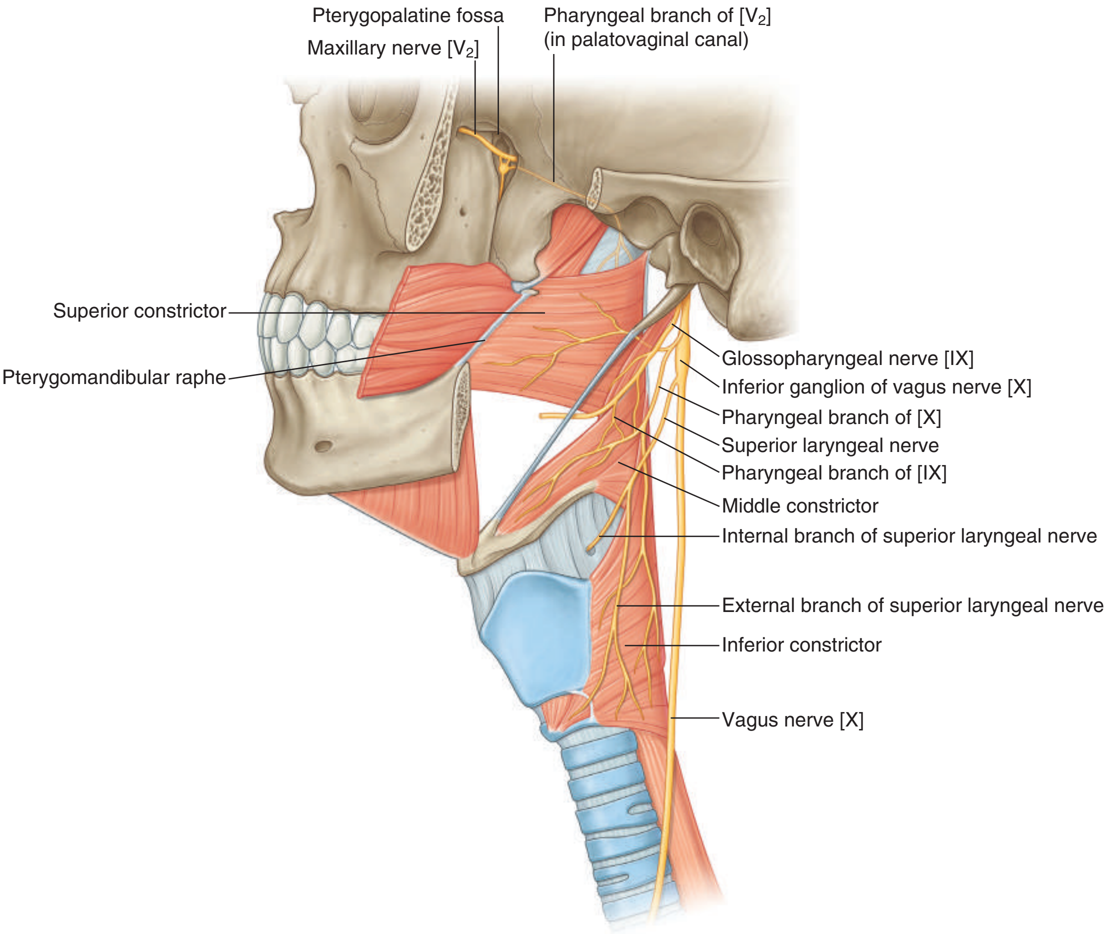

Pterygopalatine fossa
Maxillary nerve [V2]
Pharyngeal branch of [V2] (in palatovaginal canal)
Superior constrictor
Pterygomandibular raphe
Glossopharyngeal nerve [IX]
Inferior ganglion of vagus nerve [X]
Pharyngeal branch of [X]
Superior laryngeal nerve
Pharyngeal branch of [IX]
Middle constrictor
Internal branch of superior laryngeal nerve
External branch of superior laryngeal nerve
Inferior constrictor
Vagus nerve [X]

Plate 29.4 Lateral view of retropharyngeal space, with majority of neurovascular structures and muscles exposed.

- *Middle pharyngeal constrictor*: This muscle attaches to the greater cornu of the hyoid bone. At the junction of the superior and middle pharyngeal constrictors, identify the stylopharyngeus muscle and the glossopharyngeal nerve (see Fig. 29.21).
- *Inferior pharyngeal constrictor*: This muscle arises from the sides of the thyroid and cricoid cartilages. At the junction of the middle and inferior pharyngeal constrictors, identify the internal laryngeal nerve and the superior laryngeal artery (see Fig. 29.21). The inferior part of the inferior constrictor is also known as the *cricopharyngeus* muscle.

LABORATORY IDENTIFICATION CHECKLIST

NERVES

- ☐ Sympathetic trunk
- ☐ Vagus
  - ☐ Recurrent laryngeal
  - ☐ Inferior laryngeal
- ☐ Accessory
- ☐ Hypoglossal
- ☐ Glossopharyngeal

GANGLIA

- ☐ Superior cervical
- ☐ Middle cervical

ARTERIES

- ☐ Common carotid
- ☐ Internal carotid
- ☐ External carotid
- ☐ Vertebral

VEIN

- ☐ Internal jugular

MUSCLES

- ☐ Sternocleidomastoid
- ☐ Stylopharyngeus
- ☐ Superior constrictor
- ☐ Middle constrictor
- ☐ Inferior constrictor
- ☐ Longus colli

BONES

- ☐ Occipital
- ☐ Temporal
  - ☐ Mastoid process
  - ☐ Styloid process
- ☐ Hyoid
- ☐ Atlas (C1)
- ☐ Axis (C2)
- ☐ C3 to C7

CARTILAGES

- ☐ Thyroid
- ☐ Cricoid

LIGAMENTS

- ☐ Transverse, of atlas
- ☐ Alar

GLANDS

- ☐ Thyroid
- ☐ Parathyroid

FASCIAE

- ☐ Buccopharyngeal
- ☐ Retropharyngeal
- ☐ Prevertebral

CLINICAL APPLICATIONS

CRICOTHYROTOMY

Gray's Anatomy for Students: 536, 541, 543
Netter: 78, 83

Clinical Application

Procedure creates an emergent airway through the cricothyroid membrane.

Anatomic Landmarks (Figs. VIII.1 and VIII.2)

Palpation of midline structures

- Hyoid cartilage
- Thyroid cartilage
- Cricoid cartilage

Skin/subcutaneous tissue

- Cricothyroid arteries and small veins (may traverse the cricothyroid membrane)
- Cricothyroid membrane

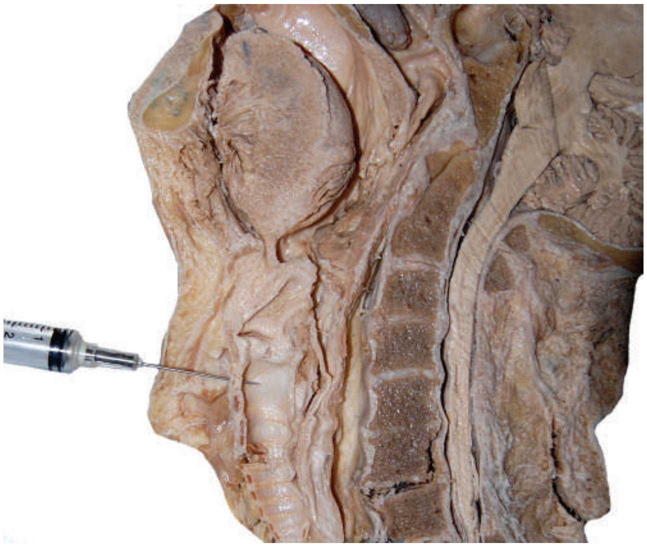


Fig. VIII.1

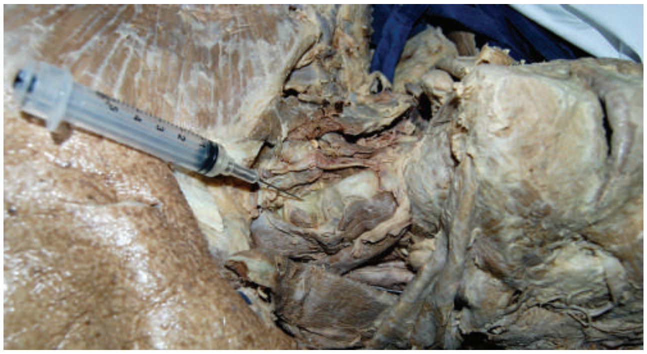


Fig. VIII.2

TRACHEAL INTUBATION

Gray's Anatomy for Students: 552, 553, 560
Netter: 68, 75, 77–79

Clinical Application

Procedure maintains and controls definitive airway by introducing a tube orally that passes through the larynx between the vocal cords, stopping before the tracheal bifurcation.

Anatomic Landmarks (Fig. VIII.3)

- Mouth
  - Incisor teeth
  - Anterior arch: palatoglossus muscle
  - Palatine tonsil
  - Posterior arch: palatopharyngeus muscle
- Oral pharynx
- Epiglottis
- Vallecula

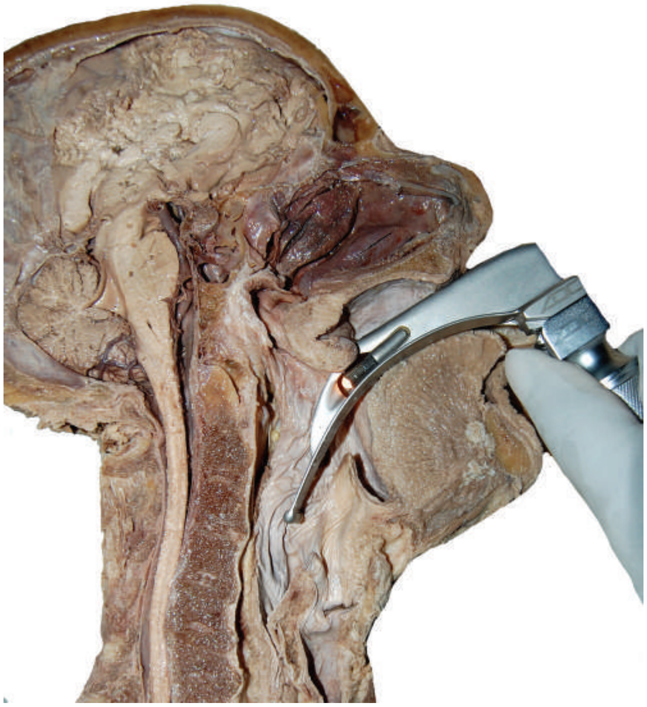


Fig. VIII.3

- Piriform recess
- Vocal cords
- Trachea

NASOTRACHEAL INTUBATION

Gray's Anatomy for Students: 552
Netter: 68, 75, 77–79

Clinical Application

Procedure maintains and controls an airway by introducing a tube nasally that passes through the oral pharynx and larynx between the vocal cords, stopping short of the tracheal bifurcation.

Anatomic Landmarks

- Right or left nostril
- Concha or turbinates
- Nasopharynx
- Oropharynx
- Laryngopharynx
- Trachea

BURR HOLES FOR CRANIOTOMY

Gray's Anatomy for Students: 490
Netter: 16

Clinical Application

Procedure creates a hole in the skull to evacuate blood from an epidural or subdural hemorrhage.

Anatomic Landmarks

- Scalp
- Skin
- Connective tissue
- Aponeurosis
- Loose areolar tissue
- Periosteum
- Bones of the calvaria
- Dura mater

AKINOSI TECHNIQUE: TRIGEMINAL-MANDIBULAR NERVE BLOCK

Gray's Anatomy for Students: 576
Netter: 133

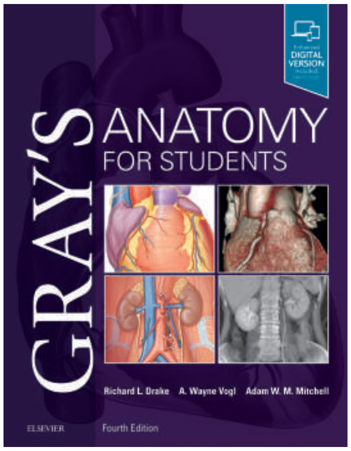
Clinical Application

Procedure allows a local anesthetic to be deposited near the mandibular division of the trigeminal nerve, when opening the mouth is prohibited.

Anatomic Landmarks

- Oral vestibule
- Mucosa medial to ramus
- Maxillary bone and mucosa
- Trigeminal nerve–mandibular nerve branches

TRUST GRAY'S



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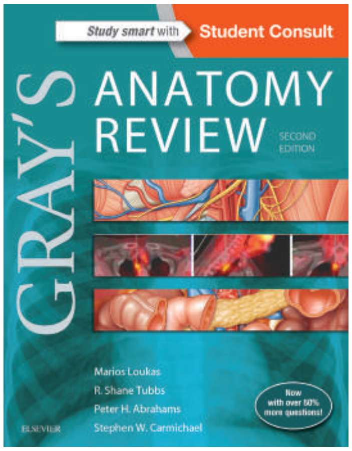

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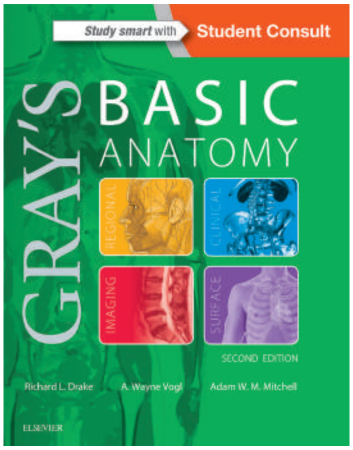

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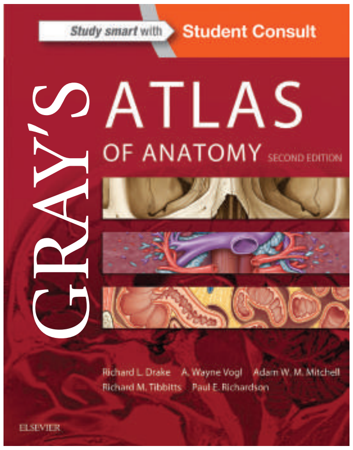

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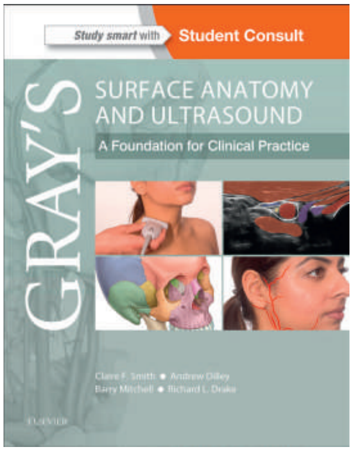

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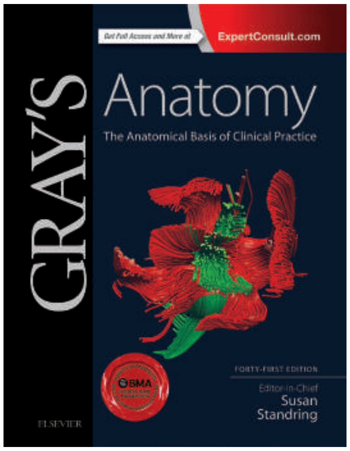

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